U.S. EPA TECHNICAL SUPPORT PROJECT
SEMI-ANNUAL MEETING
Technical Sessions Summary

May 7-10, 2001
San Diego, CA

U.S. EPA TECHNICAL SUPPORT PROJECT CO-CHAIRS

Engineering Forum:
Jo Ann Cola, Region 9 • Camille Hueni, Region 6 • Steve Kinser, Region 7

Ground Water Forum:
Kathy Davies, Region 3 • Vince Malott, Region 6

Federal Facilities Forum:
Meghan Cassidy, Region 1 • Steve Hirsh, Region 3 • Craig Thomas, Region 5

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OPENING JOINT SESSIONS

Introductory Remarks

Rich Steimle, U.S. EPA/Technology Innovation Office

Rich Steimle welcomed participants to the Spring 2001 Meeting of the Technical Support Project (TSP). He explained that the TSP Forums were established by EPA's Office of Solid Waste and Emergency Response in 1987 to improve communications among technical staff within EPA and to assist in the transfer of technical information between the Regions and the Technical Support Centers. The Ground Water Forum, Engineering Forum, and Federal Facilities Forum act as technical resources and disseminate information from the TSP to their Regional colleagues. Information is shared during monthly teleconferences. The Forums also meet semiannually to discuss technical and policy issues, new technologies, and to network with other federal agencies and states.

John Kemmerer U.S. EPA/Region 9 Chief, Superfund Cleanup Branch

John Kemmerer welcomed TSP participants to Region 9. For the past four years, John has been Branch Chief for a group of RPMs who work at non-federal facility Superfund sites in California. He was the Region 9 representative to the Engineering Forum in the late 1980s, and has always been a great admirer of the TSP. The Forums serve as conduits for communicating new ideas and technologies throughout the Agency and to the states. Thanks to the Forums' information transfer capabilities, many RPMs can make smarter remedy decisions than they could 10 years ago. In the past 10 years, the Forums have helped RPMs make decisions about numerous cleanup technologies and tactics, including soil vapor extraction, monitored natural attenuation, and institutional controls. He remarked that the sediments focus for this conference is very timely, given the attention that sediments topics have received by Congress and the National Academy of Sciences. He thanked the Forums for their continued contributions to the Superfund Program.

Jeff Grovhoug SSC San Diego, Environmental Sciences Division

Jeff Grovhoug welcomed participants to San Diego and provided a brief overview of the Space and Naval Weapons System Center's (SPAWAR) Environmental Quality Program. The Environmental Sciences Division (ESD) focuses on Research Development, Test & Evaluation (RDT&E) and environmental quality assurance and remediation, with an emphasis on the marine/estuarine environment. The goals of the Environmental Quality Program are to:

- reduce the cost of environmental compliance, cleanup, and oversight;
- minimize the risk of environmental impact from Navy operations and facilities and reduce the risk to Navy operations from environmental regulations;
- develop the capability to produce scientifically sound data and risk analysis to support Navy environmental compliance; and
- develop improved assessment, monitoring, and remediation technologies for environmental restoration and compliance.

To help meet these goals, ESD has developed the marine environmental survey capability (MESC), which is a system of sensors and real-time data acquisition designed to measure water quality. ESD is also developing environmental sensors with the capability to quickly and cost effectively assess the composition and toxicity of materials released by ship and shore operations. Another ongoing project involves the development of sediment assessment and treatment technologies that can be used to assess contaminant distribution throughout an area and analyze the sediment/contaminant interactions that control treatability and management. The Benthic Flux Sampling Device (BFSD), prototype Pore-

Water Sampler, and prototype Multi-Sample Seepage Meter are examples of additional technologies that are being researched and developed at SPAWAR.

To view Mr. Grovhoug's presentation materials for more details, please click here:

Sediments Update

EPA Sediment Remediation Conference and the Sediment Remedy Effectiveness Project

Ernie Watkins, U.S. EPA/Office of Emergency and Remedial Response

Ernie Watkins provided an overview of the upcoming *EPA Forum on Managing Contaminated Sediments at Hazardous Waste Sites* to be held May 30 and June 1, 2001, in Alexandria, Virginia. The purpose of the meeting is to facilitate an open exchange of information and viewpoints concerning cleanup of contaminated sediments, and to encourage a discussion of the key science and policy issues that should be considered in order to make the most appropriate site-specific risk management decisions that are consistent with current federal laws and regulations.

The goals of the meeting are to:

- provide a forum for all stakeholders to express their opinions on EPA program policies and guidance that address sediment remediation
- identify the key site information and data that should be collected and evaluated to make informed site-specific cleanup decisions
- identify issues that need to be resolved, additional data that needs to be gathered and evaluated, and research that needs to be performed
- shared information and lessons learned as a result of managing contaminated sediment

Various panel sessions are planned: community involvement, effects on human health and ecological resources, site characterization, remedy effectiveness, comparison of remediation technologies, and risk management frameworks. John Farrington (Associate Director for Education/Dean of Graduate Studies, Woods Hole Oceanographic Institution) is leading the National Academy of Sciences study and will deliver the keynote address.

In April, Larry Reed, Acting Director OERR, sent letters to the Branch Chief in each Region requesting information on sediment sites. OERR is compiling the information received and flagging the sites in the CERCLIS database. There was not much information gathered on removal actions, however. More recently, OERR polled the Regions on the effectiveness of remedies. Mr. Watkins noted that the sediment workgroup needs a lot of support from the Regions in a short time frame.

ORD Activities on Contaminated Sediments

Trish Erickson, U.S. EPA/National Risk Management Research Laboratory

Trish Erickson provided an update on contaminated sediments activities underway in EPA's Office of Research and Development (ORD).

National Academy of Sciences (NAS) Report

The Committee on Remediation of PCB-Contaminated Sediments led by the NAS was formed in response to the FY98 Appropriation Report. FY99 and FY01 appropriations had successively increased restrictions on sediment cleanups. A cross-office review was conducted, and the report, published in March 2001, will affect the Superfund Program significantly. The committee concluded

that PCBs in sediments may pose long-term risks; sources need to be controlled; decisions must be made on a site-specific basis; and there is no preferred or default remedy. The committee also favors using a strong risk-based decision framework, involving affected parties as partners, and evaluating a broad rage of risks for baseline and remedies. They further concluded that overall risk management may be more important than technology selection; short- and long-term risks of management options should be considered; long-term monitoring to document performance should be conducted; and further research on assessment, contaminant fate, ongoing releases, and management technologies should be conducted.

Remediation Technologies Development Forum's (RTDF) Sediment Action Team

The RTDF Sediment Action Team (www.rtdf.org/public/sediment) is made up of members from industry, consulting and research, federal and state governments, and universities. Their activities focus on information transfer and possible demonstration projects. The team held a meeting in January 2000 to discuss the monitored natural recovery of sediments and again in September 2000 to discuss in situ treatments. The team is considering linking with or conducting demonstration projects. Possible links include EPA's Great Lakes National Program Office and the Superfund Innovative Technology Evaluation (SITE) program.

Risk Management Research

The research on contaminated sediments at the National Risk Management Research Laboratory (NRMRL) in Cincinnati is focused on performance evaluation for existing technologies (dredging, capping, and natural recovery) and development and evaluation of new technologies, especially in situ technologies. Ms. Erickson provided details on each research area.

Ms. Erickson also summarized the work on natural recovery of PCB-contaminated sediments at the Sangamo-Weston/Twelvemile Creek/Lake Hartwell Superfund site in Georgia. She discussed the approach used for monitoring the natural recovery as well as the data collected, such as PCB concentration profiles, sediment age dates, and sediment accumulation rates, to estimate the time to needed achieve cleanup goals.

To view Ms. Erickson's presentation materials for more details, click here:

Questions and Answers

Question: Has the long-term erosional nature of rivers been considered in the model?
Answer: Yes. It has to be considered, and that may be a reason why capping has not been chosen very often. More often it is used for deep water systems. A good riverine candidate for capping would have a contaminant that degrades slowly over time; low energy conditions; a depositional environment such as a dam system rather than a natural system; and conditions under which the cap will stay in place for the next couple of decades after which the remaining contaminant levels will not be of concern. If the river meanders and has high scour areas, it probably is not a good candidate for capping.

Superfund Contaminated Sediment Remediation Guidance

Ernie Watkins, U.S. EPA/Office of Emergency and Remedial Response

Ernie Watkins is the leader of the workgroup that is preparing the Superfund Contaminated Sediment Remediation Guidance. The workgroup is made up of representatives from the U.S. Army Corps of Engineers, Fish & Wildlife Service, National Oceanic and Atmospheric Administration, and the Office of General Council. EPA workgroup members attending the TSP meeting include Fred Schauffler,

Gary Baumgarten, and Judith McCulley. A significant number of Superfund sites adjoin surface water bodies, which has led to sediment impacts. The guidance will be aimed at RPMs who experience working with other media, but are not familiar with sediment sites. The guidance will focus on feasibility studies, which should provide a detailed analysis of sediment risk management activities (monitored natural recovery, in situ capping, dredging, treatment and disposal, etc.) with an emphasis on persistent, bioaccumulating toxic chemicals.

Mr. Watkins outlined the chapters and appendices that will be included in the guidance. He also discussed various disruptive forces that act on sediment remedies such as tide, currents, wind, boating, dams, storm events, and bioturbation.

Questions and Answers

Question: Regarding the chapter on accessing the impact of disruptive events, if the RI is complete, are you using models to do the assessment?
Answer: No, this guidance will be aimed at people starting an RI. They should be able to read this guidance and know what information is needed to support the FS remedy selection.

Question: Have you looked at or evaluated in situ capping with sorptive or reactive materials?
Answer: No.

Question: Are you addressing cleanup standards for sediments?
Answer: We have requested data from the Regions on how their standards for cleanup were established, but there is no focus on this in the guidance. The data will be compiled and made available when the database is complete.

Question: You might want to differentiate sediment sampling for ecological risk and for fate/transport needs—they are very different types of samples. You mentioned earlier that you didn't address the site assessment/characterization portion of the problem. Are you considering another guidance to address this?
Answer: Yes. This is an issue that needs to be addressed although not in this guidance. It will likely be done in the future.

Question: Are there going to be outreach efforts or fact sheets produced regarding the guidance?
Answer: Yes. The fact sheets will be produced and presentations will be made in each Region.

Department of Energy Vadose Zone Science and Technology Roadmap

Clay Nichols, U.S. Department of Energy/Idaho Falls; Rien van Genuchten, U.S. Salinity Laboratory, U.S. Department of Agriculture; Lorne Everett, IT Group

Clay Nichols noted the paucity of research data beneath the root zone and the complexity of vadose zone fate and transport processes. There are limited monitoring capabilities in the vadose zone, and current science is insufficient to model this zone since it has both large heterogeneities and chemical/physical reactions. DOE is launching the roadmap effort to better understand vadose zone fate and transport mechanisms and hopes to refine capabilities for predicting fate and transport of chemicals in the vadose zone, if only to bound the uncertainties. DOE is focusing its work through its facilities at the Idaho National Engineering and Environmental Laboratory (INEEL).

Rien van Genuchten presented DOE's Vadose Zone Science and Technology roadmap approach and how it is being applied to the vadose zone fate and transport problem. Roadmapping is a strategic

technology planning technique used by industry and government to develop a common perspective on possible future (10-30 years) science and technology needs for making better research and development investment decisions. It identifies capability gaps in science and technology areas, provides a structure for organizing technology forecasts, and communicates science and technology needs to users and the research community.

Research on the vadose zone has been fragmented and compartmentalized. The roadmap team formed in FY 2000 consists of 62 representatives from government, academia, and industry. The team has four workgroups: physical processes, simulation and modeling, invasive characterization, and non-invasive characterization. Dr. van Genuchten described each workgroup's functions and the state of the practice, research needs, and research priority milestones for the next 25 years. For more information, consult the project's webpage at www.inel.gov/vadosezone/.

To view Dr. van Genuchten's presentation materials for more details, click here:

Questions and Answers

Lorne Everett noted that the vadose zone has been a "no-man's land." Little has changed in our investigation approach to the vadose zone—neutron probes and suction lysimeters have been used since the 1970s. There is no good model for vadose zone solute transport. Mr. Everett encouraged the TSP to build on the momentum gaining in vadose zone work. He moderated the question and answer session that followed the presentation.

Question: What is the major difference between state-of-the-art and state-of-the-practice in this area?
Answer: It would appear that getting to an accurate simulation model is in the distant future. In the near term, we should concentrate on monitoring techniques and remedial technologies that do not depend on accurate modeling.

Question: We have to balance the cost of more data collection with the cost of remediation. This approach seems to ask for more data to feed a complex model and might not help our bottom line. Some financial advantage must be seen.
Answer: For cleanups this may be true. However, for sites that are not a problem yet or are being built, early warning systems will make a difference on the bottom line for remediation. There has to be a regulatory underpinning for additional data collection, and it has to be applied consistently.

Technical Challenges for Long-Term Stewardship and Institutional Controls

Laurence B. McEwen, U.S. Department of Energy/Oakland Office

Laurence McEwen discussed issues involved with DOE's responsibilities for long-term stewardship (LTS). The DOE's primary LTS tools include institutional controls, monitoring, maintenance, information management, re-evaluation of remedies, and research and development. Nationwide, an estimated 129 DOE sites may require LTS as a result of radionuclide generation and use. DOE properties in total comprise approximately 2.5 million acres—20 percent of which likely are subject to LTS through the year 2070. Due to the persistent nature of radionuclides in the environment, researchers cannot project definitive endpoints for LTS requirements. DOE recognizes that overall LTS strategies may be strengthened through improved monitoring technologies; lower costs for site monitoring; enhanced information generation, storage, retrieval, and dissemination; and improved links between regulators and local governments dealing with institutional controls. Information on technology needs and general operations of DOE's Oakland office are available on the Internet at www.oak.doe.gov/DIVISION/STCG/home.html.

Questions and Answers

Question: What is the anticipated time frame needed for LTS at DOE sites?
Answer: Current projections estimate that LTS will be required through 2070, with site re-evaluations every five years.

JOINT SESSION ON SEDIMENTS

Subaqueous Capping of Contaminated Sediments: Field Experiences

Michael Palermo, U.S. Army Corps of Engineers/Waterways Experiment Station

Michael Palermo outlined the three general types of capping:

- level bottom or natural capping—dredged material is placed in a pile and covered by capping material
- in situ capping—capping material is placed directly over contaminated sediment
- contained aquatic disposal—a subsurface containment area is dredged out, filled with contaminated sediment, and covered by capping materials

Capping materials usually consist of granular materials, armor stone, or fabrics and membranes. Sediments can produce gases, so low permeability membrane-type caps generally are not a good idea. There is a general reliance on fate models to predict where capping materials will go as they are being placed. These models include: STFATE, MDFATE, LTFATE, CDFATE, SSFATE, and DREDGE.

Many factors have an affect on contained contaminants, including erosional scour, bioturbation, upwelling ground water, and soluble diffusion. Soluble diffusion is a long-term process that is always present, so there may be some flux of contaminants upward through the cap and into surrounding soils. Cap thickness and material mix can minimize these effects. One design consideration for placing a cap is the physical ability to place it at the desired thickness.

Since hopper dredges do not control sediment movement well, they are not appropriate for moving contaminated materials (digging or placement). However, they are useful for placement of clean materials. Submerged diffusers are sometimes used to place contaminated sediment since they slow the sediment flow velocity and allow for more control. Contaminated sediments should be allowed to settle before they are covered with clean capping material. If this is not done, then there is a danger of differential settlement and mixing between the clean and contaminated materials.

Dr. Palermo summarized specific field experiences that included:

- New York Mud Dump: Until the 1980s and 90s, contaminated dredge materials were placed at the dump. Now these sediments are being covered by clean materials using a hopper technique.

- One Tree Island Marina: Cleanup is being done using a “flip-flop” method. Contaminated sediments are removed and placed in barges. The excavated area is deepened, and these soils are placed in other hoppers. When the excavation reaches a specified depth, the contaminated sediments are placed in it and covered with the deeper soils.

- Ross Island, Portland Oregon: Large borrow pits for gravel were dug into the ocean floor, filled with contaminated sediments, and covered with clean fill. A problem occurred when the gravel company dug into one of the contaminated areas which illustrates the need for strict institutional controls.

To view Dr. Palermo’s presentation materials for more details, click here:

The Role of Ecological Modeling in Assessing Natural Recovery of Sediments

Rob Pastorok, Exponent Environmental Group

Rob Pastorok explained that there are tools to help clarify assumptions and identify uncertainties. These tools do not always provide precise or accurate answers, and sometimes mechanistic models are better than statistical ones. Eco-modeling is a device to assess the effect of chemicals on populations. It is not an exposure model like that used in human health risk assessment. The presentation centered on three major topics:

Selection of ecological endpoints for monitoring or assessing natural recovery of sediments
Monitoring the natural recovery of sediments or declaring an area "recovered," requires defining specific endpoints that can be measured and clearly understood. Endpoints should reflect some measure of population abundance, the distribution of organisms in the environment, and the diversity of species and species age structure. The presence or absence of species—or individuals within a species—is not a sufficient measure of recovery unless it is an endangered species. For a community assessment, it is often possible to measure the community directly. Toxicity testing of the sediments can be done, but these data need some empirical basis so they can be extrapolated to the general population. If the empirical relationships are not available, modeling is the next choice.

Defining recovery targets relative to valued resources and natural variability
How do you define where you want to be at the endpoint? This can be done by defining an acceptable mean and variance of population within the community, or by comparing the community makeup with a reference area (e.g., multivariate similarity index). Temporal and spatial dynamics of the system must be considered. Defining a recovery point requires stakeholder consensus before the data are collected. Interpreting endpoints and recovery data can be difficult because there can be a wide, non-linear, natural variance of populations over time. Several specific case histories were shown to demonstrate this point.

The role of ecological modeling in monitored natural recovery
Ecological models help define recovery targets and interpret monitoring data during recovery. The American Chemistry Council is funding a study to evaluate extrapolation, population, ecosystem, and landscape ecological models. The results should be available at the end of this year. Dr. Pastorok summarized the specific types of models available and their use.

To view Dr. Pastorok's presentation materials for more details, click here:

Questions and Answers

Question: Is recovery defined as the system reaching its carrying capacity?
Answer: Recovery is defined as steady state equilibrium.

Question: It has been decades since the eutrophication problem has been fixed in the mayfly example you showed. What does the mayfly population look like now?
Answer: It has fully recovered.

Discharge of Mercury-Contaminated Ground Water to Lavaca Bay

Gary Baumgarten, U.S. EPA/Region 6

The Aluminum Company of America (ALCOA)/Lavaca Bay Superfund site is located on the Gulf Coast of Texas in Calhoun County. The site encompasses the ALCOA Point Comfort Operations

(PCO) Plant, an associated dredge spoil island, and portions of Lavaca Bay. The Beaumont Formation underlies the site and generally consists of a sequence of silty clays, sandy clayey silts, clays, and silty sands. The major chemicals of potential concern (COPCs) in Lavaca Bay sediments include mercury and PAHs.

The PCO plant began operation as an aluminum smelter utilizing alumina as the raw material to produce aluminum metal. The smelter operated from 1948 until 1980. From 1966 into the 1970s, ALCOA operated a chlorine-alkali plant that produced chlorine gas and sodium hydroxide. Mercury cathodes were used for part of the process. Wastewater containing mercury was discharged into Lavaca Bay through outfalls located on an off-shore gypsum lagoon located on Dredge Island. Sizable beads of mercury have been found in cores taken on and near the site. These beads are confined in a structural depression that prevents the elemental mercury from entering the Bay. ALCOA has installed four extractor wells in the Chlor Alkali Process Area (CAPA). The bulk of the flux in the system (85%) is in the North Central area. In 1998, recovery wells pumped 10 gpm in an attempt to equalize the flow of ground water into and out of the system. The recovery wells have greatly reduced concentrations of mercury in the ground water. They also keep the ground water level below the surface water level of the Bay.

To view Mr. Baumgarten's presentation materials for more details, click here:

Questions and Answers

Question: What is the extent of vertical migration of the elemental mercury?
Answer: There does not appear to be potential for the mercury to go deeper than Zone B2.

Question: How comfortable are you with the topography of upper Zone C where the structural depression is located?
Answer: It appears that there is a low depression that could serve as a transportation mechanism for elemental mercury into the Bay.

Question: Do you plan to phase the cleanup? Will you remove any of the contaminated media?
Answer: We have no plans to excavate and remove materials—that would be too costly (on the order of $20-30 million). The recovery wells are a low tech/low cost solution.

Question: Is the mercury in the ground water dissolved?
Answer: It is in a dissolved ionic phase.

Question: How do you plan to treat the discharge water?
Answer: We will use carbon adsorption with air stripping.

Geophysical Techniques for Studies of Shallow Water Sediments

Mark Vendl and Gary Cygan, U.S. EPA Region 5

Geophysics is a technique that remotely investigates and defines and object or material in the subsurface without direct contact with that object or material. All geophysical methods measure physical properties of subsurface materials and contained fluids. The most useful properties are resistivity (or the inverse, conductivity), seismic velocity, density, and magnetic susceptibility. These measurements can be used to characterize the geology and hydrogeology of a site as well as to locate buried man-made features. The success of all geophysical methods depends on the existence of a sufficient contrast between measured properties of the target and background conditions.

Geophysics can provide a cost effective method to remotely investigate and define the subsurface conditions of a site without extensive coring. Among the more useful geophysical methods are ground-penetrating radar (GPR), seismic reflection, DC relativity, magnetics, electromagnetics, seismic refraction, gravity, and spontaneous potential. GPR provides the highest resolution of all methods and works by sensing changes in electrical properties of buried objects. The major limitation of GPR is its site-specific performance. The depth of penetration is limited by the presence of mineralogic clays or high-conductivity pore fluids. In marine environments, GPR normally works to a maximum depth of 20 feet.

Continuous Seismic Profiling (CSP) is another popular geophysical method. CSP operates under the same basic principles of wave propagation and reflection. Reflections occur at interfaces with changes in acoustic impedance. The frequency of the seismic signal determines the depth of penetration and resolution. High-frequency, short-wavelength signals provide high resolution but have less depth of penetration, while low-frequency waves have lower resolution but penetrate to greater depths. Seismic signals can be scattered by gas or air bubbles, so the use of CSP in gassing organic materials is limited.

In conclusion, geophysical techniques provide more complete datasets for decision making. Geographic Information Systems (GIS) used in conjunction with geophysical data can provide useful facies maps. GPR and CSP can be used to help map contaminants based on sediment type.

To view Mr. Vendl's and Mr. Cygan's presentation materials, including a summary of a case study focusing on techniques used at the Hudson River, click here:

Questions and Answers

Question: For what range of water depths can GPR be used?
Answer: The maximum depth is 20-30 feet, and the minimum is about 3 feet. An alternative approach is to wait until the stream or pond freezes to use GPR.

Question: If GPR is limited by water depth, why don't you just submerge the unit so that it is closer to the benthos?
Answer: This has been done and works well for clean bottom lakes. The main problem with this technique is that the unit often gets snagged on debris in rivers.

Question: Can you use GPR to look for creosote and coal tar?
Answer: Yes. GPR has been used to search for coal tar and creosote. The Technology Innovation Office conducted a demonstration at a coal tar site. In Region 5, we were able to see creosote pits at one site in Chicago. We have also been able to see gasoline on the water table based on changes in the electrical signal.

Comment: Most of these tools were developed for land use but recently have been adapted for use in water. As more information on the instruments is published and discussed, we will begin to see them engineered for aquatic and marine use.

RPM PANEL DISCUSSION: SEDIMENTS REMEDIATION

ALCOA/Lavaca Bay Superfund Site

Gary Baumgarten, EPA/Region 6

Gary Baumgarten discussed the interactions of ground water with surface water in Lavaca Bay, Texas, which drains into the Gulf of Mexico. Mercury and PAH contaminants from past smelting and bauxite refining operations at the area's ALCOA Plant have become buried in bay sediments adjacent to the plant. Remedial investigation studies have been conducted to more closely locate the contaminants, estimate the length of time contaminants are expected to remain in the sediments, and better understand the impact of sediment re-circulation.

Studies have shown localized areas of contamination, with highest mercury concentrations located closest to the contaminant source, and the existence of mercury and PAH DNAPLs. Studies also show that high levels of mercury found in the surface sediments are due to ongoing contamination, rather than re-circulation of buried sediments. In addition, modeling has predicted little effect on mercury levels in sediments as a result of scouring during hurricane events.

Based on these studies, remediation efforts in Lavaca Bay will include primary source removal, control of secondary sources (mercury-contaminated sediments), control of mercury discharge into Lavaca Bay, control of the PAH DNAPL reaching Lavaca Bay, continued finfish and shellfish tissue monitoring, natural recovery by sedimentation, and dredging.

To view Mr. Baumgarten's presentation materials for more details, click here:

Caps, Croakers, and Institutional Controls: An Overview of the Palos Verdes Shelf

Fred Schauffler, EPA/Region 9

Fred Schauffler provided an overview of cleanup actions underway to remove PCBs from sediments located on the Palos Verdes Shelf, south of Los Angeles. As a result of DDT manufacturing operations conducted by Montrose Chemical from the 1940s through the 1980s, PCBs were released directly from the main operational yards, and process wastewater was released through the local sewage system into the Pacific Ocean. PCBs have been identified in the adjacent continental shelf area as well as the continental slope. In addition, PCB concentrations as high as 200 ppm have been measured in sediments (ranging in depth from 1 inch to 2 feet) of the nearby Los Angeles River discharge area.

Cleanup planning began in 1990 with initiation of a Natural Resources Damage Assessment, followed in 1996 by commencement of Superfund investigations and initial dredging. In situ capping was recommended as a remedial option in 1999, and implemented in pilot form during 2000 to demonstrate constructability, evaluate short-term impacts of cap placement, and evaluate various capping methods and materials. The pilot area comprises three 200-yard by 300-yard capping cells that employ two different capping materials, two water depths, and three placement methods. Extensive monitoring of the pilot is conducted through sediment cores, sediment profiles, water samples, side-scan sonar, current meters, ADISS systems on dredging equipment, underwater videos, and acoustic sub-bottom profiling.

Preliminary results of the capping pilot indicate that disturbance of contaminated sediments was localized and decreased substantially after the initial load placement. Sediment plumes caused by the capping were not found to pose a risk to nearshore kelp beds, and there was no indication of mass sediment movement as a result of capping.

As part of the site remedy, institutional controls have been proposed to limit commercial and recreational fishing. PCBs have been found to be pervasive in food web pathways, and in the Palos Verdes Shelf this issue poses a particular threat through the consumption of white croakers. Institutional controls include implementing fishing bans and installing warning signs throughout the Palos Verdes area.

To view Mr. Schauffler's presentation materials for more details, click here:

Soda Lake Capping Case Study

Vickie Meredith, Wyoming Department of Environmental Quality

Vickie Meredith described the collaborative efforts undertaken by Amoco, the State of Wyoming, and the local community to address contamination at Soda Lake, Wyoming. As a natural playa basin, Soda Lake comprises approximately 100 acres set in a shale/sandstone depression with natural salinity levels exceeding 50,000 ppm. The lake is recharged by runoff each spring, but then becomes dry later in the year. Amoco's refinery in Casper began rerouting its process water to Soda Lake in the late 1950s to avoid discharge to the North Platte River. As a result, the lake increased in size from 100 to more than 650 acres, and the area began serving as a significant wildlife habitat.

A 45-acre portion of the area known as Inlet Basin provided a final settling pond for the process waters. Remediation of Inlet Basin was prompted when studies showed that PAH levels exceeded most sediment criteria, and birds were found to be exposed to high levels of PAH. After considering three primary remedial options (enhanced natural attenuation, dredging, and capping), a capping demonstration project was initiated to demonstrate the viability of capping, test cap placement models, ensure the effectiveness of cap design, and provide data supporting the final remedy selected as part of the site's RCRA corrective measures.

The demonstration cap consists of 18 inches of native sand obtained from a nearby hilltop. Testing indicated insufficient compressive strength of the surface sediments, so the cap was designed to embed itself into the soft sediments, with the lower sand layers of the cap serving as a foundation for the clean upper zones. To minimize disturbance of bird nesting activity, cap construction was confined to periods preceding June 15 and after August 31, 2000. A barge was used to apply capping material in deep water areas, while shallow areas were sprayed.

Results from the first 3-month round of cap monitoring indicate that the upper 2 feet of the cap contain no organic contaminants at levels exceeding screening criteria, and that short-term effects from the cap placement were minimal. Although tests show that the cap is physically stable, the potential long-term integrity of the system is under evaluation. Until final remedy selection, Amoco will continue pumping approximately 2 million gallons of water each day from the North Platte River to Soda Lake to maintain the existing wildlife habitat and developing wetlands, as well as to minimize the odors caused by lake evaporation. Based on the results of the capping case study, final remedies for Soda Lake will be selected by the end of 2001.

To view Ms. Meredith's presentation materials for more details, click here:

New Bedford Harbor

Dave Dickerson, U.S. EPA/Region 1

The New Bedford Harbor Superfund Site in Massachusetts was listed on the NPL in September 1983. It is an 18,000-acre urban estuary reaching from the Acushnet River into Buzzards Bay. Its sediments

are highly contaminated with PCBs and heavy metals. The five worst acres of PCB-contaminated sediment were removed from the Acushnet River in 1994 and 1995 and shipped to an offsite landfill. Phase two of the cleanup will involve dredging approximately 170 acres in the upper and lower harbors to contain around 450,000 cubic yards of PCB-contaminated sediments in four shoreline confined disposal facilities. The entire upper harbor will be dredged using a hybrid mechanical/hydraulic dredge. The ROD upper-limit estimate for this cleanup is $325 million. Most of the money will be spent on offsite transport and disposal. Overhead will be the second most costly component.

PCB concentrations in sediments range from a few parts per million (ppm) to over 100,000 ppm. PCB levels as high as 10 ppm in fish tissue have been measured in certain areas at the site; 10 ppm is five times the FDA's action level of 2 ppm for PCBs. Thousands of acres have been closed to the harvesting of shellfish, finfish, and lobsters since New Bedford Harbor's appearance on the NPL. In the upper harbor, species richness is low.

U.S. Army Corps of Engineers Sites

Mike Palermo, U.S. Army Corps of Engineers/Waterways Experiment Station

Mike Palermo presented two case studies dealing with environmental dredging of contaminated sediments. The technology exists to survey, dredge, transport, place, and treat contaminated sediments, but is expensive. There are 3 "Rs" to environmental dredging: resuspension, release, and residual. When planning for environmental dredging, several considerations must be taken into account, including the accuracy and precision of the dredge, the resuspension of sediment, and presence of residual sediment. The production and efficiency of the removal is also an important consideration.

Conventional dredges include cutter head, hopper, and clam shell rigs. Slope cleaners and sweep rigs are specialty dredges. Mr. Palermo discussed two case studies where environmental dredging was employed. At the Marathon Battery Superfund site on the Hudson River, a wetland was contaminated with cadmium, nickel, and cobalt. A combination mechanical and hydraulic dredge was used for cleanup. At Bayou Bonfouca, Louisiana, 160,000 yards of creosote-contaminated sediment was removed and treated. The specialty dredge used for the cleanup had spuds that were used to stabilize the dredge.

In conclusion, there is no universal solution for removing contaminated sediments. Conventional equipment works well, and specialty equipment is available for challenging or unconventional cleanups. All dredges will resuspend some sediment. The unique nature of the sediment at a specific site must be taken into consideration when planning for dredging activities.

St. Lawrence River

Anne Kelly, U.S. EPA/Region 2

A portion of the St. Lawrence River in upstate New York is contaminated with waste from three hazardous waste sites: the General Motors site, the Reynolds Metal Company site, and the ALCOA Aggregate site. Several issues make these sites unique, including their proximity to the Canadian border and the presence of the Mohawk Tribe, which is a subsistence fishing population.

The General Motors Site is a 165-acre aluminum casting facility on the St. Lawrence River. The site contains two areas that have received an estimated 30,000 cubic yards of PCB-contaminated sludges generated from recycling of hydraulic oil used in the plant's machinery. A portion of the waste lies below the water table. An additional 9,000 gallons of contaminated oil are stored in an abandoned

pump house. Analyses by the State indicate that ground water and surface water are contaminated on the site. Runoff is toward the Raquette River, St. Lawrence River, and the St. Regis Indian Reservation—all about l,000 feet from the site. The company's response to an information request letter indicates there are other areas of concern at the facility.

The 1,600-acre Reynolds Metals site is an active aluminum production plant. Land use in the area is predominantly residential and industrial. The site is bordered to the north by the Grasse and St. Lawrence Rivers, to the east by the New York Central Railroad, to the west by Haverstock Road, and to the south by the Raquette River. The contamination detected in the waste, ground water, leachate, and surface water is characterized by elevated concentrations of cyanides, fluorides, sulfates, aluminum, and PAHs. PCBs also are detected in both areas at concentrations as high as 690 ppm. EPA plans to dredge approximately 77,600 cubic yards of river sediments contaminated with several chemicals, including PCBs above 1 ppm. After dredging, contaminated sediments with PCB levels below 50 ppm will be safely disposed of onsite. Sediments with PCB levels between 50 and 500 ppm will be shipped offsite for disposal at an approved landfill. The most contaminated dredged material, with PCB levels above 500 ppm, will be sent to an appropriate offsite facility for treatment.

The ALCOA Aggregate site contains six miles of PCB-contaminated sediments. Overall, there is a low level of contamination spread over a large area, with limited hot spots.

Several issues at these sites make cleanup decisions more complicated. These include the presence of boulders on the bottom of the river, the short field season, and the low cleanup levels. Ms. Kelly noted some of the complications she has encountered in the first two weeks on the job. The project is already three weeks behind schedule, access to oversight contractors has been denied, there has been an unauthorized sampling event, and there have been significant design changes without approval.

To view, Ms. Kelly's presentation materials for more details, click here:

Panel Question and Answer Session

Question: Was any methyl mercury detected at Lavaca Bay?
Answer: Methyl mercury was detected in the bay sediment and examined to some extent. Although methyl mercury was the most toxic and primary bioaccumulating substance found in fish tissue, total mercury levels were studied because of the significantly lower costs involved.

Question: What was the cost of the Palos Verdes Shelf pilot study?
Answer: The cost was slightly over $5 million, excluding costs for EPA staff involved in the project. This amount reflects significant cost savings gained by coordinating the study with the ongoing dredging. In this way, dredging equipment was not required to be on standby while monitoring occurred.

Question: What was the cost of the 1994 "hot spot" removal at New Bedford Harbor?
Answer: The total cost was $45 million, including expenses for terminating the existing incineration operations and all long-term monitoring. The dredging portion of the project was completed for less than $30 million.

Question: What is being done with the treatment water at Lavaca Bay?
Answer: Water containing carbon tetrachloride and mercury is pumped out (at a rate of approximately 10 gpm) and run through a carbon absorption system. The resulting

effluent is discharged into the bay in accordance with requirements established for this project by the State of Texas.

Question: At Soda Lake, how will the long-term isolation be evaluated?
Answer: A specific monitoring plan will be established when the final remedy for this site is selected. The monitoring plan is expected to include periodic sampling of the pore water, surface sediment, and benthic organisms. The re-colonization of benthic organisms in the surface sediment is seen as an important indicator of the project's success, since none were found prior to the pilot project. In addition, the results of predictive modeling that was conducted prior to cap placement will be used to track whether the anticipated sediment changes are actually occurring. The findings from other sediment studies will help to evaluate this project.

Comment: The Palos Verdes Shelf report contains relevant information that may be useful at other sites such as this. The report is available at the U.S. Army Corps of Engineers' (USACE) Waterways Experiment Station website, www.wes.army.mil.

Question: Was the work at New Bedford Harbor a PRP-lead project?
Answer: The work was completed as a Fund-lead project. The project was cashed out with the PRPs in 1992 at a level of $100 million, with EPA receiving approximately $67 million and the trustees receiving the remainder. Since that time, USACE contractors have been used for the design process, thereby avoiding the long wait for procurement of new contractors.

Question: In light of the problems encountered reaching a concentration level of 1 ppm in ground water at the GM site, how was that goal selected again at the Reynolds site?
Answer: Cleanup goals were based on fish consumption data provided by the Mohawk Tribe, and balanced against levels that were achievable through the selected remediation technology.

Question: At New Bedford Harbor, how were the dikes created?
Answer: The three smaller dikes were earthen, but the large dike underwent a number of design changes. After finding that the original design specified in the ROD was not effective, a 65-foot diameter interconnected sheet pile structure was constructed. Soft in situ sediment was removed and replaced with an engineering-quality sand and gravel fill. Sheet piles containing additional sand and gravel then were driven around a template to provide a very strong structure.

Question: Have any health studies been conducted since the 1995 dredging that show reduced exposure in the Mohawk Tribe population around the St. Lawrence River?
Answer: Some studies have shown decreased PCB exposure since that time, primarily due to the fishing bans that were put into place. Documentation of the beneficial effects of dredging is nearly impossible due to the size and diversity of the multiple contamination sources involved in this area. The potential for impacts from residual contamination, upstream sources, and other sources (such as those previously identified on the tribal properties) adds to the difficulties in determining exposure in the area.

Question: Have any worm studies been used to determine bioaccumulation levels of concern?

Answer: Yes, the USACE guidance manuals address the use of sand worms to determine bioaccumulation levels in the marine environment. In the terrestrial environment, earth worms are used for this purpose. The use of worm studies for bioaccumulation evaluation depends on the particular site being remediated, as well as the pathways involved. Marine worms also are a common species used for the 28-day bioaccumulation test conducted prior to ocean disposal of waste.

Question: Has any organization considered the use of measuring sediment trends, i.e., measuring the tidal effects of sediment to avoid dredging problems and unnecessary work?

Answer: Sediment transport modeling is a useful tool in baseline studies and serves as an indicator of the potential for natural recovery.

Question: In the opinion of each panel member, what currently is the biggest data gap and research need?

Answers: At Lavaca Bay, a fuller understanding of the relationship between the contaminated sediment and biota accumulation (i.e., the changes in biota caused by certain chemical concentrations) is needed, including factors such as salinity and the food patterns of larger species.

Since the effectiveness of the Palos Verdes capping project is limited by the sediment system's extensive size and depth, it would be useful to have a better understanding of the balance between the project's benefit to the ecosystem and the impacts of contaminant remaining in deeper portions of the system.

The same holds true for the GE site, where more information regarding the impact of residual, low-level contamination is needed.

Based on the Waterways Experiment Station's experiences, an area needing more attention is how to determine the effectiveness of remedial options. More specifically, methods are needed to compare the risk reductions and overall benefits resulting from the use of different remedies.

At New Bedford, extensive modeling in the 1980s indicated that dredging eventually would reach the targeted cleanup goals. As more sampling is conducted, however, it has become increasingly apparent that sediment contamination is heterogenous and difficult to track, both horizontally and vertically. Better methods are needed to address these problems.

Measures for defining the success of remediation are needed. At the Soda Lake site, complete sampling of the cap, pore water, and sediment can be conducted, but it is not known whether ecological receptors may be impacted in the future. For example, the effect of wind erosion on the shoreline along the cap was difficult to predict in the absence of an applicable model.

Question: Is the equipment used by the USACE to dewater sediments the same as that used to dewater industrial or POTW sludges?

Answer: Different equipment is used to mechanically dewater sediments, such as hydrocylones and belt filter presses. Prior to mechanical dewatering, however, phase separation of the sediment needs to be addressed. Generally, the coarse portion of a sediment can be

separated more easily and less expensively than a finer sediment, which is likely to have higher levels of contamination.

Question: How did EPA turn around the New Bedford Harbor community's negative sentiment toward the project when it was inherited by EPA?

Answer: All of the project stakeholders initially met to identify specific issues of concern, with help from a neutral facilitator. Additional meetings were held until agreements concerning the final remedy selection were reached.

Question: What problems do underwater obstructions such as rocks or logs pose to capping?

Answer: Underwater obstructions did not pose a problem at the Soda Lake site.

The USACE addressed this problem at two paper mills sites in Alaska with many sunken logs and (non-toxic) organic-contaminated sediments. It was recognized that uniform capping could not be achieved due to curvature variances, but that the cap could achieve partial risk reduction. Generally, underwater obstructions do not preclude the use of capping nor suggest that incremental risk reduction cannot be obtained.

The exact location of the cap to be installed at the Reynolds site will not be determined until dredging is complete. It is anticipated, however, that capping design modifications will be made to accommodate the obstructions likely to appear.

Underwater obstructions may be viewed similar to the occasional gaps that are found in cap liners, and neither type of imperfection should be treated as a fatal flaw of the capping system.

Question: Why was the sediment at Bayou Bonfuca incinerated before it was landfilled?

Answer: As one of the first major Superfund sites where a sediment remedy was implemented, the lack of related experience and technologies available at that time to address sediment contamination may have been major factors.

Question: Generally, how were models used in these projects, and how well did the models predict the outcomes?

Answers: Many models have been used for the Palos Verdes Shelf pilot project, but it is too early to assess their success. The models may be significantly affected by the various sediment depths addressed.

At New Bedford Harbor, models were used in the late 1980s as a comparative tool but not as a tool for determining final cleanup levels. Instead of further pursuing ground truthing to follow up on the modeling projections, greater effort has been placed on conducting long-term benthic monitoring over the past decade.

Primary consolidation modeling was used and found to be accurate at Soda Lake, but the diffusion models that were used have yet to be evaluated.

At Lavaca Bay, extensive hurricane modeling is used to evaluate potential scouring in the Bay. Until a category-5 hurricane event occurs, however, the success of this modeling cannot be evaluated.

Models for the ALCOA/Grasse River site are under development as part of the current remedial investigation process.

Question: If the health of the benthic community is the reason for capping at these sites, how has the benthic community (including shellfish) been affected by capping and how well has it recovered?

Answer: At the GM site, the benthic community (including mussels) is recovering in terms of increased populations, but contaminant concentrations in organisms are still high. Due to the existence of upstream sources, the impacts of capping cannot be clearly identified.

USACE has found that capping and dredging will eliminate benthic organisms, as well as the contaminants. As a result, new populations can grow in a clean benthic environment.

At New Bedford, benthic organisms will be destroyed but recolonization is expected to occur within a couple of years.

In the Palos Verdes Shelf, complete destruction of benthic organisms is not expected because of continued fertilization from the outfall system. Over the course of cap construction, a short-term death of benthic organisms will occur in areas where construction is actively occurring, but should be balanced by repopulation in areas where construction already has been completed.

No benthic community existed at the Soda Lake inlet basin prior to placement of the cap, so any increase to the population will be favorable. A very different benthic community exists at Soda Lake proper due to salinity levels.

Question: Is information on the three Superfund sites located in the Grasse River area shared, and if so, is the sharing voluntary or is there a formal agreement to share information?

Answer: Information on the three sites is shared informally among the three groups, and also under three separate agreements directly with EPA. In addition, two of the involved facilities have entered into a formal agreement with the Trustee group and are conducting a joint assessment of the entire impacted area.

Question: What techniques are used at the capping sites to ensure the caps are performing as designed and predicted?

Answer: At the Soda Lake demonstration, periodic sampling and monitoring of the sediment, pore water, and benthic organisms are conducted.

At the GM site, an annual inspection of the cap is conducted. Ongoing techniques to ensure the cap's performance include video monitoring of the cap integrity and monitoring of the fish populations.

Since the Palos Verdes Shelf project is a pilot project, a long-term plan has not been developed. If fully implemented, however, performance of the cap would be evaluated through inspection of the cap's thickness, sediment sampling, long-term sampling of fish tissues, and possibly water column testing.

Question: Does the contaminant concentration in caps increase over time, and if so, how does this relate to the depth of the cap?

Answer: USACE designs a cap precisely to examine this process and to evaluate the long-term changes occurring in a cap. When evaluating a cap, the upper portion will contain contaminant material that will reach a peak concentration and then recede. A primary objective of capping is to ensure that this peak concentration is below the target; if it is not, capping is not an appropriate remediation technology.

Question: Do these site communities (excluding PRPs and outside environmental groups) prefer contaminant removal instead of containment?

Answer: In the St. Lawrence River area, communities strongly prefer removal, particularly in light of the need to make decisions that can be validated for seven or more generations.

At New Bedford, the PRPs had requested that capping technology be used. The community itself did not express a preference and generally agreed with EPA's recommendation to dredge.

For Lavaca Bay, monthly meetings were held to help educate the community. As a result, the community understands that some areas require dredging while others simply require time for sedimentation to occur. The community strongly requests, however, that the fishing ban be lifted.

In the Palos Verdes Shelf area, community preference is difficult to define. Generally, the public would like the fishing advisories and area closures to end, and wish for the contaminant problems to be resolved simply and quickly.

The Soda Lake community's preference is evenly split, recognizing that capping will help to preserve local wildlife habitat, while dredging will terminate the flow of water entering the basin. Community preference is swayed by past experience; a suspension of water flow in 1991 resulted in the release of strongly offensive odors from the basin.

Question: Aside from these cleanup actions, have other ecosystem restoration activities been conducted, and have the ecosystem benefits from cleanup actions been determined?

Answer: A number of ecosystem restoration activities are in the planning stages for the Palos Verdes Shelf.

Similarly, several projects are planned for the ALCOA site in Lavaca Bay, including construction of oyster beds, marsh areas, and fishing piers. Implementation of these plans, however, cannot occur until a ROD is completed.

Restoration activities are not planned for the two St. Lawrence River dredging sites, but the need for future restoration work will be evaluated in five-year reviews and during ongoing monitoring.

A key objective of work at the New Bedford site is to improve the marine ecosystem through contaminant removal from the sediment. During shoreline excavation, it is anticipated that large marshes containing invasive plant species will be replanted with indigenous marine grasses, which also will reduce backfilling costs.

No ecological restoration activities are planned at the Soda Lake site. Both the U.S. Fish and Wildlife Service and the Wyoming Game and Fish Department, however, are actively involved in the remedy selection process.

Question: What level of assessment work was required for cleanup actions at each of these sites?

Answer: For the Soda Lake basin, work progressed directly to remedy implementation instead of risk assessment due to the high concentrations of contaminant found in the sediment. At Soda Lake itself, high contaminant levels generally were not found. For some constituents exceeding Tier I values in the lake, however, bioassays were conducted to determine the impacts of contaminated sediments.

At the New Bedford site, additional sediment sampling during earlier stages of the project would have been very helpful. In addition, data gaps regarding the wetlands and intertidal systems of the harbor existed when remedy implementation began. Striking a balance between the collection of additional assessment data and moving forward with a remedy, however, remains a difficult process at most sites.

Striking this balance also was difficult at Lavaca Bay, especially in light of the magnitude and complexity of the contamination problem. Extensive funding (approximately $40 million) was spent on remedial investigations for the bay, in part due to strong cooperation with the PRPs.

Data used for the Palos Verdes Shelf area were compiled by the trustees as part of the National Resources Damage Assessment, at a cost exceeding $30 million. In addition, outfall monitoring data collected routinely by the Los Angeles County Sanitation District are used extensively for this project. EPA has expended its funding for the pilot project, but could use more assessment data.

On USACE sediment studies, the adequacy of assessment data is always a question. Data needs seem to become evident as a project progresses, and in particular, the characterization of large sites frequently involves some false starts.

At the St. Lawrence River site, a sufficient degree of data seems to exist, but additional assessment on the downstream impacts (extending onto Canadian properties) would be useful.

Question: How were stakeholders brought to the decision-making process for these sites?

Answer: Stakeholder opinions were found to change over time. Meetings regarding the New Bedford site were held with as many stakeholders as possible, as frequently as possible.

Due to the large size of the Palos Verdes Shelf stakeholder community, a technical advisory committee representing federal, state, local, and PRP organizations was established to provide a technical discussion forum. Although this approach did not function well due to the extensive litigation involved, it is anticipated that future stakeholder negotiations will be more effective now that a related lawsuit has been settled. Generally, it seems impossible to hold these types of discussions without some degree of stakeholder contention.

At Soda Lake, a collaborative process was established under the federal RCRA settlement with Amoco. As part of a resulting consent decree with the State of Wyoming, the local governments have set up a stakeholder group known as the Amoco Reuse Agreement Joint Powers Board. The process of systematic development of informed consent (SDIC) was used to identify stakeholders most likely to oppose the proposed remediation plans and in need of one-on-one discussions. The SDIC process has proven to be very effective for the Soda Lake project.

A cooperative management agreement among EPA, the State of Texas, and the U.S. Department of Commerce requires Lavaca Bay cleanup activities to be approved by all three organizations prior to any work being initiated. Although addressing the related concerns of various sectors of the federal and state government has proved challenging, this working group has worked effectively. The local navigation district, however, has questioned or disagreed with many of the project plans, and generally has presented the greatest number of stakeholder problems.

USACE is aware of the recent National Academy of Science report in which EPA is criticized for operating the Superfund process in a linear process (i.e., EPA proposes a remedy and then requests public comment). Based on the project experiences described here and elsewhere, the criticism seems unjustified. The actual process used by EPA is not linear because public input usually is obtained prior to remedy proposal/selection.

The primary stakeholder community for the St. Lawrence River area is the Mohawk Tribe, with which EPA has worked throughout the cleanup process. As with any cleanup project, diverse and conflicting comments on the proposed actions have been received and addressed as much as possible.

Question: From past experiences, what advice can be passed on to other Regions and offices?

Good information on dredging experiences at New Bedford Harbor should be available. This project can serve as a showcase for the use of state-of-the-art dredging technologies and presents an approach for long-term monitoring at other sediment sites.

Experiences in the St. Lawrence River area suggest that combinations of remedies and techniques often can be more effective and more easily accepted than a single remediation technology.

The Lavaca Bay experiences indicate that the measures for evaluating project success need to be clearly identified and be made to reflect various elements such as time requirements, sampling/monitoring needs, and back-up plans Another significant finding has been that, in practice, preliminary design work for remediation can occur while RI/FS work is underway.

Palos Verdes Shelf experiences show that it is always best to “expect the unexpected.” Sediment remediation projects such as these always involve parties who disagree with the proposed or selected site remedies. To prepare for these disagreements, it is useful to solicit many diverse technical opinions, and, in particular, those regarding fish consumption scenarios. EPA’s future guidance on sediment remediation is anticipated

to include extensive information gained from project managers involved at other sediment sites.

USACE's experiences have clearly shown that contaminated sediment sites are very different from contaminated soil sites. Experience also indicates that a remedy is always site-specific, and that there is no standard way of addressing sediment contamination problems.

USGS PRESENTATIONS

Welcome, Introduction, and Overview
Eric Reichard, USGS

USGS is organized into four discipline divisions: water resources, geologic, national mapping, and biological resources. Within the water resources division, every state has a district office. Their charge is both to look at water resource issues of national interest and to address specific water management needs and concerns of public agencies within the state. Their funding is also reflected in these charges as they receive funding from the USGS itself as well as from local agencies to collaborate on local issues. The materials that will be presented today are a mix of field equipment and statistical/modeling tools for data interpretation.

Applications of the USGS Flowmeter and Depth Dependent "Izzmobile" Sampler
Randy Hanson, USGS

USGS developed the "Izzmobile"—an instrument that collects ground-water samples and measures flow at different depths within a well bore—to better evaluate production well performance and design. Water production wells often are screened across multiple aquifers or multiple producing zones. These zones can contribute different volumes of water and different water qualities to the well. It is important to know where these zones exist and how they will contribute to the overall flow volume and water quality.

The USGS is working on a new package to MODFLOW called Multi-Aquifer Well Bore Flow. The package simulates the well bore flow as water is pumped to show how it reaches a dynamic equilibrium. It can be used to improve the assessment of flow systems within a well bore and the effects of flow on the chemistry load. As an example, Mr. Hanson showed a simulation of a two-layer system with different pumping rates and how these rates affect the mix from the layers.

Using the Izzmobile to collect data over a long well screen, it can be shown in some wells that there is little well bore flow (water coming into the well) from a large portion of the screened interval. This also has implications for water quality.

Well flow logging has several distinct benefits:
- Quality assurance for sampling and assessing the possibility of skimming
- Monitoring network design (best placement of well screens)
- Understanding how the flow system works
- Evaluation of remedial designs
- Aids in well maintenance and longevity

The Izzmobile is a trailer-mounted, high pressure hose system. This design enables its use in very difficult entry tubes on turbine pump systems. The trailer has all the sampling equipment and can run dye tracing with the capability of getting real time data, which can be used as a surrogate for well velocity. The typical production well has less than two inches of clearance, which does not allow for standard geophysical tools. The Izzmobile has a sample tube that can be opened to take a discrete water sample at a given depth and then closed for surface retrieval. Mr. Hanson gave an example of an agricultural production well with a potential chloride problem that originated in a portion of the screened interval that contributed less than 10 percent of the water. The chloride-producing formation was a marine sediment and also was contributing other chemicals that affected well maintenance costs.

By using flowmeters and discrete sampling devices in existing wells in a basin, one can make some very valid assumptions on how deep the production wells (and, in some instances, monitoring wells) should be and where screens should be placed.

USGS is using trace elements such as strontium 86 and 87 and boron isotopes to look at the hydrostratigraphy of the San Jose area. In another example, he showed where they had isolated cation inflow and found that a well's iron problem was coming from a shallow portion of the screened interval.

Because of ground-water withdrawal, there is a problem with subsidence in Southern California. To counteract this, a large amount of very pure water is imported from Northern California and injected. The USGS examined where the injected water going in the subsurface. Based on data from the Izzmobile, the majority of the recharge water is staying in the shallow part of the aquifer.

In an example in San Bernardino, the stratigraphy and geophysical logs and chemistry results did not support the presence of a break in the formation. Yet the flowmeter results showed a definite break in flow coming into the well at a specific depth interval. In another example of a production well that exhibited arsenic, boron, and fluoride problems, depth-specific sampling indicated that the arsenic was coming from a formation near the bottom of the well, while the boron and fluoride were from a shallower part of the screened interval. The specific conductivity of the two waters was nearly the same.

In conclusion, well construction, access design, and well bore flow are very important for interpreting information for both production and monitoring wells. Combining flowmeter and water quality data for mixing estimates and chemical contribution is something USGS advocates and promotes in their studies. Indirect data such as lithology and geophysical data are necessary, but may not be sufficient to characterize complex layered aquifer systems. Multiple data types further constrain the properties of the conceptual system.

Questions and Answers

Question: What is skimming?
Answer: Skimming is when the sample you take is not representative of the aquifer—for example, where only one part of the screened interval is contributing to the water in the well bore.

Question: Could you define "representative"?
Answer: Representative samples would be samples that are representative of what is in the aquifer, not necessarily what is in the well bore. So if you have different flow rates in different parts of the aquifer, you really need multiple samples to get a full spectrum of what the integrated sample from a well bore actually represents.

Question: What is the probe measuring as it is going down the well? How are you pulling the water samples?
Answer: The probe performs depth-dependent sampling. The VOC sampler is made from Teflon tubing and has sufficient volume to fill three 40-mL VOC vials. The tube is sealed until it reaches the desired depth where the check valve is released and then closed. The probe can also be filled with rhodomine dye to measure flow velocity.

Applications of the 3-Dimensional Wellbore Flowmeter

Mark Newhouse, USGS

The prototype Borehole Acoustic Doppler Velocimeter (B-ADV) was developed for EPA by Sontek. It has a 4 conductor Century Drawworks for logging, a digital depth counter that is accurate to 0.01 feet, and real-time data acquisition software. It measures particles entrained in the well bore water. An acoustic source at the bottom of the instrument emits a sound that bounces off of particles moving across its range; receivers convert this bouncing into a directional flow. The flow is converted by the software into horizontal and vertical vectors with a combination of the two giving the true flow (dip) direction. A built-in compass allows the system to orient the flow on a 360 degree system (i.e., 0° is north, 90° is east, etc.). The compass may not work in steel/iron cased wells, however. Because the tool can be somewhat intrusive and is tracking particles, logging is conducted downwards so the particles being tracked have not been disturbed by the tool. For small diameter wells, the size of the tool will interfere with measurements of downward vertical gradients. Particle tracking also allows the calculation of flow velocities.

USGS started out doing work in the San Diego area and then took the B-ADV to Indiana and Kentucky to work in carbonate rock. They participated in a study that compared various flowmeters in the same wells. The results of that study, which will be published soon, indicated they all yielded different results.

USGS also completed a project in fractured rock in Idaho. They found two fracture zones with different velocities and flow headings. The upper system seemed to be flowing toward a local stream, while the lower appeared to be regional and flowing towards the Snake River. The calculated velocities were quite high, and it is not certain whether they are true velocities or an artifact of the tool.

In carbonate bedrock at Fort Campbell, there was very little indication of flow until the instrument encountered a fracture zone. As it passed out of the zone, the flow dropped off. Pumping relationships in fractured bedrock may not be very linear.

Injection wells in Southern California bring clean water from the Colorado River and inject it to replenish the water being withdrawn by various supply wells. The water being injected was shown to exit the injection well as soon as possible (as indicated by flow direction and velocity in the screened interval) and does not really reach the lower zones. In addition, flow in observation wells was found to change with depth, and the water becomes cooler and more conductive. It is believed that there are now two flow zones: one created by the injection water and “natural” conditions; and the other, which flows from the coast to the inland, the result of salt water intrusion that the injection wells are not preventing. The injection wells should probably be redesigned to place their screened intervals deeper so the water is forced deeper.

Questions and Answers

Question: Wouldn’t a 3.1-inch probe limit the use of B-ADV in monitoring wells?
Answer: Yes, a 4-inch diameter well is needed to use it. The designer of the tool has indicated that if the array is shrunk anymore, it will lose accuracy.

Question: Is there a minimum level of turbidity that is needed for accuracy?
Answer: Yes. The water can be too clean, but we haven’t run into that problem yet. We measure the total dissolved solids before hand as a check.

New Drilling and Coring Capabilities and Applications
Steve Crawford, USGS

Steve Crawford discussed the types of drilling that USGS employs and demonstrated the types of data they can collect. An example of a new tool is INSAR for downhole imagery. It requires calibration, which can be done with cores and porosity information to correlate the imagery. Mr. Crawford cited an example of correlating chemical, geophysical, and lithological data to obtain a more complete picture of the subsurface and form a tighter conceptual model of the flow regime. The calibrated geophysical data can then be extrapolated in other areas where the chemistry and lithology data may not be as complete.

One of the most popular drilling methods is air rotary percussion. It provides continuous coring while driving a steel casing just behind the drill bit and allows for various types of real time sampling. The next most popular drilling method is mud rotary which is used primarily for well installation. It is not very good for soil samples, but soil cores can be obtained. The new favorite way of continuous drilling uses a wire line to retrieve cores and can get over 1,000 feet of continuous core over a 20-day period. These cores are relatively undisturbed.

The USGS is using onsite laboratories for a project in Los Angeles. The laboratories are capable of several tests including p-wave velocity, density, and magnetic accessibility. The cores are split and photographed using a high quality camera that can be used for grain size analysis. The data are then entered in real time for analysis.

The specific capabilities of the USGS office in San Diego include:
- air percussion hammer drilling, with or without under reaming casing
- direct or reverse circulation mud rotary drilling to 1,500 feet
- wire-line, direct circulation mud rotary drilling to 2,500 feet
- coring for all types of methods
- complete suite of geophysical downhole tools
- CPT and augering capabilities

Questions and Answers

Question: Does USGS do rotosonic drilling?
Answer: No. The rigs are expensive and break down a lot. Also, they don't work in some types of environments, such as clay. The cores are heated so a lot of parameters can't be measured.

Question: Whose system do you use for mud rotary?
Answer: We use Christensen's wire-line, direct circulation mud rotary, which obtains 2.4-inch cores. We use the 5-foot core barrel for unconsolidated materials, and the 10-foot long core barrel for consolidated sediment and rock.

Fate, Movement, and Transport of Recharged Wastewater in the Los Angeles Basin
Roy Schroeder, USGS

Roy Schroeder explained that recycled wastewater has been used since the early 1960s for ground-water recharge in the Los Angeles Basin. In addition to meeting all drinking water quality standards, the recycled water cannot contribute more than 1 mg/L of organic carbon and 1 mg/L of nitrogen to the ground water. In addition, there are setback or travel time requirements for pathogens. The USGS

study examined approximately 50 different analytes. At this particular site, the recycled water cannot make up more than 35 percent of the total recharge on a three-year running average.

The recharge system consists of two surface water basins that occupy approximately 1,000 acres. Ground water flows from the recharge area southward towards the Pacific Ocean, a distance of approximately 30-40 km. These basins receive water from wastewater treatment, storm water runoff , and imported water from Northern California and the Colorado River. The average recharge is about 150,000 acre-feet per year.

The USGS study was conducted in three phases. The first involved constructing a sampling site at one of the basins where they could look at very localized changes in water quality inputs. They placed monitoring wells, piezometers, and lysimeters in the basin near a catwalk for access so they could collect samples from depths of up to 50 feet. They then examined the water quality at nearby production wells that would give a picture of the processes over a period of weeks to several years. In the third portion of the study they identified and sampled points where travel times would be on the order of 30 years.

Based on the data collected at the basin, it was discovered that the recharge water did not penetrate as deep as they had thought and would dilute out after the recharge source was turned off. They found that about one-third of the TOC in the recharge water was removed during percolation, and this did not depend on previous conditions. For nitrates, the amount removed was 20-60 percent, and it was highly dependent upon prior conditions in the basin. The wastewater changes redox conditions to a varying degree, which results in a varying degree of denitrification.

There are 23 deep production wells pumping at greater than 2,000 gpm that are within 500 feet of the recharge basins. A previous study done by a consulting firm had estimated that the travel time from the basins to these production wells would be anywhere from a few weeks to years. All 23 of the wells were sampled for evidence of wastewater constituents. There was no neat pattern in the results that could be expected since the screening intervals on these wells ranged up to 500 feet and they were clearly drawing water of different age from different depths.

The best inorganic indicators for the presence of wastewater in the production wells were chloride, nitrate, and boron. Using these inorganic parameters, the percentage of the water in the production wells that had a wastewater origin was estimated. The results showed good correlation, with the upper end of the estimate being 60 percent. When organic chemicals were used, there also was a good correlation, but the upper end estimate was 20 percent. This indicated that inorganic indicators over-estimated the amount of wastewater present, while organic indicators under-estimated it. It also was found that the method of introducing the wastewater to the basins resulted in both aerating the wastewater and entraining air into the subsurface. This has implications on the potential for biodegradation.

Five wells clusters located considerably downgradient from the basins were sampled both to determine age of the water and to see if any wastewater-related constituents might be identified. Tritium in the deepest wells indicated pre-1950's water. However, evidence of degraded sulfonate surfactants (soap), which indicated the presence of wastewater, was found in three of the locations. The sampling and analysis procedures used were designed to give detection limits up to six orders of magnitude lower than standard EPA analytical methods; it typically required a day per well to collect the required sample volumes.

A second study was conducted to look at attenuation of pathogens in the wastewater recharge basins. USGS found, using a flow model and their wells in the basin, that the most conservative pathogens should not travel more than 100 feet from the recharge basin.

Questions and Answers

Question: How did you measure air parameters in the water to show that excess, non-dissolved air was being trapped in the water column?
Answer: Basically by measuring nitrogen and argon. The nitrogen to argon ratio that dissolves into the water at equilibrium is a function of temperature. So if you know the temperature, you know what the nitrogen to argon ratio should be. The atmosphere, on the other hand, has a different ratio, so you can impose this on the amount found in the water and the deviation between the two will tell you how much excess air was injected. There are two complications in this method, however. One is that you need to know the recharge temperature, and the second is the effect of denitification, which changes the nitrate concentration. We hope to better quantify our results in the remainder of the study.

Question: What was the chemical surfactant that you found?
Answer: It was a surfactant from detergents.

Question: Have you looked at pharmaceuticals?
Answer: No, but we may consider this in the future.

Question: Have you looked for caffeine?
Answer: Yes. Caffeine is present in the downgradient ground water, but not at the basin. The sanitation district is very good at taking organics out. Caffeine may have been present historically, however.

Question: Have you examined the evolution of the degradation products through time in the subsurface?
Answer: No. The products we are seeing are very degraded and we don't really have enough sampling data to do this.

Question: You said you looked at borates related to detergents. Did that work out?
Answer: Yes. The borates were a good indicator.

Question: What would you say to people in other parts of the country that may be considering this type of recharge scenario?
Answer: I believe that if the sanitary district had it to do over again, they would not have located the supply wells and recharge basins so close together. Other than that, they can't really find any reason not to do it.

Question: You're putting highly treated water into these basins. What do you think about less treated water or storm water?
Answer: There could be a danger of driving the aquifer into a reducing state by using lesser treated water. However, the recharge water at the basin was not always highly treated. It was secondary treated until recently. It uses tertiary treatment now (dual media filtration, chlorination, sulfites, and oxidation).

Question: Did your bacterial modeling show that there should be a virus problem or not?
Answer: There should not be. There are two or three wells that will fall within the100-150-foot distance predicted by the model. The county tests these wells regularly and they haven't seen a problem. While they do get an occasional hit, it does not correlate with anything else.

Tracing Anthropogenic Compounds Through the Urban Hydrologic Cycle
Ken Belitz, USGS

Ken Belitz explained that the USGS initiated the National Water Quality Assessment Program (NAWQA) in 1991 to assess the quality of freshwater streams and aquifers. There are more than 50 study units throughout the country in the program, with a broad range of settings. National synthesis groups integrate the results of the studies to obtain regional and national perspectives on water quality. The USGS currently tests for EC, pH, dissolved oxygen, turbidity, alkalinity, major ions, nitrates, phosphorus, pesticides, total suspended organics, total dissolved organics, volatile organic compounds (VOCs), semi-volatile organic compounds, trace elements, and isotopes. Method detection limits (MDL) were set to minimize false positives. The laboratory reporting limit (LRL) was set to minimize false negatives and is equal to about two times the MDL.

The USGS is also participating in the State VOC Project in California. This is a collaborative effort between USGS, the State Water Resources Control Board, Department of Health Services, and the Lawrence Livermore National Laboratory (LLNL). The purpose of the project is to evaluate the vulnerability of public supply wells to VOC contamination. To address this issue, they are looking at VOCs in production wells, LLNL is providing data on tritium and helium dating, and they are also looking at stable isotopes.

NAWQA is evaluating the water quality of the Santa Ana Basin, which is located south of Los Angeles and occupies about 2,700 square miles. Of this area, about 50 percent is developed. The land that could be developed is 80 percent. The Santa Ana Basin is bordered by the Pacific Ocean to the southwest, the San Gabriel Mountains to the northwest, the San Bernardino Mountains to the northeast, and the San Jacinto Mountains to the southeast. The Santa Ana Mountains divide the Santa Ana Basin into coastal and inland areas. The headwaters of the Santa Ana River, which runs across the basin to the Pacific Ocean, are in the San Bernardino Mountains.

The most productive water zone in the aquifer is between 500 and 1,000 feet bgs. The Orange County Water District, like the Los Angeles Water District, has a wastewater recharge program. The system is dominated by focused recharge and distributive pumping. The Orange County Water District has produced a flow map showing a radial pattern that is wedge shaped, with recharge occurring at the point of the wedge and flowing outward. Mr. Belitz presented the results of a three-year sampling program for a stream just upstream of the basin recharge area. The study looked at 45 pesticides and found 16 at or above their LRL. These pesticides are at concentrations in the ng/L range and are primarily associated with landscape and highway right-of-way uses. The pesticide diazinon was detected in almost all of the stream samples collected throughout the year and is ubiquitous (although at very low levels). Eight or nine of the 85 VOCs tested were detected. The most commonly found were chloroform and bromodichloromethane—both disinfectants. The next most common are petroleum-related VOCs such as BTEX. The presence of a number of the VOCs in the stream can be explained as air-related with their concentrations being in equilibrium with those found in the air. The one exception is TCE, which is ground-water related.

Twenty wells were sampled, 17 of which are municipal supply wells. The wells showing the most pesticides and VOCs were those closest to the recharge area. As the distance of the well from the area

increases, a smaller and smaller subset of chemicals was found until only VOCs were found. In general, every time pesticides were detected in the water, VOCs were detected as well. Almost every time VOCs were found, tritium was found. The wells farthest out contain only tritium. This indicates that the aquifer is acting like a chromatographic column with the pesticides being retained and the tritium moving the fastest. The conclusion is that recharge water has displaced natural waters in the Santa Ana for a distance up to 20 kilometers from the recharge area.

More information on this program can be found at http://water.wr.usgs.gov/sana_nawqa.

Questions and Answers

Question: Are the atrazine concentrations you've seen correlated with recharge since it is a pretty large compound?
Answer: We have not looked specifically at correlating atrazine with recharge, but in general, it was found in the surface water, not the subsurface.

Question: How about lindane?
Answer: Lindane was not found in the coastal plain.

Incorporating Core Samples into Studies of Streambed Sediment Samples in Assessment of Pesticides, Trace Elements, and SVOCs

Carmen Burton, USGS

Carmen Burton indicated that NAWQA established the Reconstructed Trends Program to address the problem of evaluating trends in chemical deposition over time when there is very little comparative data. To do this, the program looked at stream sediments and sediments in lakes and reservoirs that should theoretically contain a depositional record of persistent chemicals and metals. Three reservoir sites were chosen to represent three different conditions: Lake Hemet, which represents air depositional conditions (background or low anthropogenic impact); West Street Basin, which represents old urban (i.e., pre 1950s) conditions; and Canyon Lake near Lake Elsinore, which represents modern urban (i.e., post 1960s) conditions. They took sediment core samples from the reservoirs and divided them by depth for chemical analysis and dating. In addition, they took sediment samples at 12 stream sites. At the stream sites, they collected the top 1-2 cm of sediment at several locations along a sampling reach and composited them.

The results of the core work indicate that levels of DDT and chlordane reached a high around 1970 and have been falling since. Methoxychlor, on the other hand, has been increasing over time. Its primary use is in the cut flower industry, and may be a result of a point source in the area. Several PAHs were detected in the cores in the 10-50 µg/kg range. Lead was shown to decline over time as a result of banning lead in fuels. In the stream beds, they generally found low levels of DDE and DDT. In general, the old urban basin had higher levels of contaminants than the other two. In addition, there were some peaks in the core data that seemed to correlate with high precipitation events that followed extended dry spells, which would result in concentrated sediment loads.

In conclusion, the bed sediments are similar to the new urban core data. The Santa Ana DDT values are higher than the national average. Concentrations of the hydrophobic organic compounds are higher in the urban areas than in the non-urban areas. Reservoir cores can be used to determine historical trends for hydrophobic compounds and low solubility inorganics.

Questions and Answers

Question: Were you surprised by the PCB results in the bed sediment samples?.
Answer: We did only detected PCBs in one bed sediment sample, but we did find it at high concentrations in fish tissue. So while it isn't in the sediments now, it obviously had been at one time.

Question: How did you date the sediments?
Answer: We correlated cesium levels with DDT and lead peaks.

Question: For PCB analysis, did you do arochlor or congener analyses?
Answer: We analyzed for arochlors, but not congeners.

Comment: There were two interesting spikes of chlorinated pesticides in core samples—one around 1970 when EPA stopped registering DDT as a pesticide, and the other about a decade later when chlordane was banned.
Answer: Yes, the peaks may correspond to banning of DDT and chlordane.

Application of Optimization Techniques to a Regional Ground-Water Flow System that Contains Multiple Contaminant Plumes

Wes Danskin, USGS

Wes Danskin discussed the structure and hydrogeology of the Santa Ana Basin with a focus on the headland area around San Bernardino and Riverside. The surrounding mountains are 12,000 feet high and consequently, there can be a lot of runoff to recharge the Santa Ana Basin. The area is also tectonically active with a number of fault lines. Originally, the recharge filled the basin, and a fault-controlled area to the south was a marsh. Since then, the water table has been lowered by supply well pumping, and the marsh has disappeared. There are several VOC plumes in the area, and arsenic and other metals are upwelling from fault areas. Also, there are a large number of old abandoned wells that are probably responsible for causing preferential flow pathways between units throughout the area.

These various features, plumes, and an idea of what is "politically possible" must be figured into system optimization. To do this, Mr. Danskin suggested the following steps:

- Identify and meet decision makers to obtain their perceptions.
- Define what the water management problem is. (It takes about three to six months to determine exactly what the desired end result is.)
- Formulate the problem mathematically (for modeling purposes).
- Choose the computer codes (e.g., MODMAN or other software).
- Solve the optimization problem (use sensitivity analysis to identify points of high uncertainty).
- Develop regional water management monitoring system (to get a better idea of uncertainties and to determine if the solution is working).
- Implement the plan.

Two models should be developed: one for the immediate problem area; and a regional one to keep track of boundary conditions. Mr. Danskin provided an example of how he could not set good boundary conditions for his finite difference model, so his faith in the results was not strong. He also suggested that the model be run for a long time (20 plus years).

Questions and Answers

Question: What is the thickest part of the unsaturated zone?
Answer: The unsaturated zone is generally 200 feet thick, but about 1foot thick at the marsh.

Question: Has the complexion of the marsh changed over time?
Answer: The marsh is still there, but it has been urbanized. Water still rises to the surface at times and it is unlikely that it can be economically dewatered. Following World War II, there a climatic dry spell and the marsh dried up. A lot of settlement in the area followed, and the defense industry built up. When the climatic conditions returned to normal, the marsh was wet again and there is not much that can be done about it.

FIELD TRIP TO NAVY SPAWAR SYSTEMS CENTER (SSC) SAN DIEGO AND NORTH ISLAND

Welcome and Overview of the Environmental Sciences Division at SSC San Diego

Captain Christopher Stathos, SSC San Diego

Captain Stathos, the Commanding Officer at the Naval Submarine Base, San Diego, and of Naval Base Point Loma, welcomed the TSP participants to SSC San Diego. He noted that the submarine base, training facilities, and SSC have been consolidated into Naval Base Point Loma. Captain Stathos is also the Chief of Staff for Environmental Programs at the base. Seventy-five people work in the environmental programs dealing with soil, water, air, natural resources, pollution prevention, etc. Navy Region Southwest encompasses the same states as EPA Region 9. Several bases fall under this region, including the Naval Base Point Loma, Naval Air Facility El Centro, Naval Weapons Station Seal Beach, and Naval Base Coronado.

The Navy shares a common goal with regional environmental programs, the California EPA, and the other groups they work with: stewardship of the environment. It is important for these varied groups to share ideas and information and correct the sins of the past. Teamwork and compromise are needed.

There has been considerable change in the technologies relating to submarines, such as the reduction of pollution and wastes. The Navy Environmental Leadership Program is partnering with local industries to improve other submarine processes. For instance, can local industries help develop an aqueous parts cleaner to avoid use and disposal of solvents. Such a development would benefit both the Navy and the developer.

For the past 15 years, the Navy has been focusing its efforts on point sources. The next step is to look at the broader picture, such as watershed-wide issues and non-point sources. Captain Stathos concluded by saying that we also need to look at process as a whole. He hopes to continue partnering with regulators on these issues.

Questions and Answers

Question: Navy sites in EPA Region 1 often point to research being done at SSC San Diego. Is this the case?
Answer: Yes. SSC is one of the central research and development centers for the Navy. We focus our research on assessment and remediation technologies for marine applications. However, there are other laboratories with different missions, such as the U.S. Naval Research Laboratory (basic and applied research) and the Naval Surface Warfare Center in the Washington, DC, area.

Question: Is there any institution or formal way the Navy exchanges research information among its facilities?
Answer: An annual Installation Restoration conference at Port Hueneme is held to share information and to dispel misunderstandings and falsehoods with good science. Perhaps the Navy can find a way for EPA to partner with these meetings.

Navy Region Southwest Water Quality Initiatives

Rob Chichester, Southwest Division, Naval Facilities Engineering Command

Rob Chichester summarized the various initiatives the Navy is taking to improve the water quality of the San Diego Bay. These included:

- Formation of a Storm Water Working Group that coordinates activities to prevent storm water pollution. The SWWG includes subcommittees on data management (Geographical Information Systems) and storm water best management practices (BMPs). There is also a Community Outreach Subcommittee that promotes new Navy programs and replaces old ideas about the military and the environment.

- Replacement of treated wood pier pilings with recycled plastic pier pilings.

- Construction of oily waste treatment facilities to eliminate the need for ships to pump to barges and thus reduce the risk of oily waste spills to the bay.

- Monitoring the water quality of the bay, which included developing a database and a hydrodynamic/contaminant transport model.

- Formation of a Toxic Hot Spots Working Group to address four of five toxic hot spots in the bay. The group is also working with the Regional Water Quality Control Board (RWQCB) to support total maximum daily loads (TMDLs) at the Chollas and Paleta Creeks.

To view Mr. Chichester's presentation materials for more details, click here:

Questions and Answers

Question: What is being done with the old wood pilings that have been replaced with plastic?
Answer: They are being properly disposed.

Question: How do you know that the decrease in PAHs in the bay is due to the removal of the pilings?
Answer: Through direct measurements and fingerprinting of the PAHs.

Question: What is the cost difference between the wood and plastic pilings?
Answer: The wood pilings are cheaper.

Question: Are phthalate compounds leaching out of the plastic pilings?
Answer: We have not measured this.

Question: Does the Navy still use tributyl tin?
Answer: Tributyl tin was tested in the 1980s, but was never implemented Navy-wide.

Southwest Division Installation Restoration Sediment Projects

Mark Bonsavage, Southwest Division, Naval Facilities Engineering Command

Mark Bonsavage began by discussing the role of the Naval Facilities Engineering Command (NAVFACENG) and the part the Southwest Division plays. The Southwest division is one of four Engineering Field Divisions within the NAVFACENG, and it handles the planning, design, and acquisition of facilities. It also provides technical advice and assistance on the maintenance and

operation of facilities and handles the acquisition and disposal of real estate. Mr. Bonsavage described a number of Southwest Division's dredging projects including:

- Maintenance dredging for the Navy Submersible Dry-dock at the Subbase, San Diego
- Pier 3 dredging and ocean/upland disposal at Naval Station, San Diego
- Replacement Pier and Dredging at Naval Station, San Diego
- Operations Training Maintenance Management Plan and Environmental Impact Statement, at the Naval Base Coronado

He went on to explain the Navy/Marine Corps Installation Restoration Program and described some of its projects such as:

- San Diego Bay environmental cleanup projects
- Site 10 shoreline slag removal at Naval Air Station, North Island
- North Island Sites 1 and 9

Mr. Bonsavage showed examples of the various risk endpoints that the Navy must consider such as eel grass, sea lions, rays, amphipods, shrimp, clams, and top smelt.

To view Mr. Bonsavage's presentation materials for more details for more information on Southwest Division projects, click here:

Questions and Answers

Question: Is the TCE plume discharge area at Site 9 broad or at isolated points?
Answer: The discharge area is not very large, and seepage is slow due to the low gradient.

Techniques for Evaluating Contaminant Exchange and Exposure at the Sediment/Water Interface

Bart Chadwick, SSC San Diego, Marine Environmental Quality Branch

Dr. Chadwick discussed three technologies that the Navy is using to evaluate contaminant exchange and exposure at the sediment/water interface:

1) *Benthic flux sampling device*, which measures diffusional fluxes of contaminants between the sediment and the overlying water

2) *Diver-deployed pore-water probe,* which measures interfacial water concentrations at a specified depth within the sediment

3) *Multi-sample seepage meter*, which measures ground water/contaminant seepage in regions of ground-water migration and tidal influence

He summarized the data and results from recent testing and demonstration studies for each of the technologies. In conclusion, Dr. Chadwick indicated that pore water probes provide a reliable way of determining the concentrations and extent of a VOC plume near the point of exposure. Multi-sample seepage meters provide direct measurement of water and chemical migration across the interface. And tidal pumping/mixing represents a potentially important mechanism in the transport and attenuation of contaminants across the interface.

To view Dr. Chadwick's presentation materials for more details, click here:

Questions and Answers

Question: Is the benthic flux sampling device measuring flux due to diffusion or water moving up through the chamber?
Answer: The device is measuring bioirrigation only. The chamber does not allow advection.

Question: In the Seaplane Lagoon example, why did the flux increase linearly? Shouldn't it be constant?
Answer: The flux *is* constant. The concentration was increasing, not the flux.

Question: Does the device measure dissolved oxygen?
Answer: Yes.

Question: How did you interpret the decrease in concentration observed in the pore water probe example?
Answer: The decrease was attributed to dilution.

Question: There was a wide spacing of the sampling locations. Will you go back to the site and look to see if higher concentrations were missed?
Answer: We have focused in on these areas in the most recent round of sampling.

Question: Have you done any analytical work on the starting concentrations within the bags of the tidal seepage meter?
Answer: Yes. We were able to detect some VOCs.

Question: How do you know you've erased the memory effect of the water from the water column?
Answer: We characterize the water in the water column before it is deployed. We assume the concentration in the bag was what we started with.

Question: Did you collect your one-foot needle samples at low tide?
Answer: Yes.

Question: Are sediments similar or different at the sampling points?
Answer: They are different. The sediments at sampling points further are offshore were finer grained. The effects of porosity on water flow are important.

Question: The pore water concentrations were lower than the concentrations measured with the seepage meter. Why?
Answer: They were actually not that different. They were within an order of magnitude.

Question: Was the vented water fresh or saline?
Answer: It was primarily saline although there was some fresh ground water from coming from irrigation.

Question: Is there an intertidal zone in the area?
Answer: Yes. But the beach is mildly sloped with rip rap along the edge. Our measurements were in the subtidal area. We could not take measurements in the rip rap area

Rapid Sediment Characterization Tools

Vikki Kirtay, SSC San Diego, Environmental Sciences Division

Vikki Kirtay explained that rapid sediment characterization (RSC) tools are field transportable analytical tools that provide measurements of chemical, biological, or physical parameters on a real-time or near-time basis. RSC tools include x-ray fluorescence for metals, UV fluorescence for organics, immunoassays, QuikSed bioassays, as well as particle size, moisture, and density measurements. The Navy needs improved sediment assessment and management techniques given the increased regulatory attention that sediments are receiving and the number of the Navy's contaminated sediment sites. RSC tools can be used along with standard laboratory data to reduce the number of costly analyses; map contaminated sediment volumes more efficiently; increase the probability of successful, high-impact sampling; and fill in data gaps; and reduce uncertainty at several steps of the RI/FS process without the enormous cost of traditional resampling efforts.

Ms. Kirtay summarized the advantages and limitations of various RSC tools and presented case studies showing their support of many of the study objectives at Hunters Point Shipyard and the Naval Weapons Station Seal Beach. In summary, RSC tools can be a useful part of a well-planned, cost-effective site assessment. Direct comparison of screening data with standard laboratory data have demonstrated where RSC data has enhanced traditional approaches. The ongoing use and development of RSC tools and applications are encouraged by regulators and by Navy policy.

To view Ms. Kirtay's presentation materials for more details, click here:

Site Characterization and Analysis Penetrometer System (SCAPS) Introduction

Steve Lieberman, SSC San Diego, Environmental Chemistry/Biotechnology Branch

Steve Lieberman began by summarizing how the Site Characterization and Analysis Penetrometer System (SCAPS) has enhanced traditional site characterizations. For instance, SCAPS makes it easier to find maximum concentrations of contaminants due to increased sampling coverage and faster turnaround of analytical results. Traditional cone penetrometer rigs have instrumented probes fitted to strain gages and sleeve friction devices for geotechnical information. Mr. Lieberman summarized the development of sensor systems that have been developed for the rigs, such as laser-induced fluorescence for petroleum sensing, laser-induced breakdown spectroscopy for metals sensing, and soil video imaging for viewing the characteristics of solvents and soil. He provided case studies illustrating their use at sites, including video clips showing changes in mineralogy and lithology and NAPL micro-globules. He concluded that direct push sensor data provide real-time, high resolution measurement of subsurface contaminants and lithology. They can be used as an "exploration" tool to rapidly delineate contaminant distributions and migration pathways. And they complement traditional sampling and analysis methods.

To view Mr. Lieberman's presentation materials for more details, click here:

Chemical Oxidation Site

Richard Wong, IT Group

Rich Wong summarized the in situ chemical oxidation process that was pilot-tested at Installation Restoration Site 5, located at the southeast corner of Naval Air Station North Island. The ground-water plume, which contains vinyl chloride and *cis*-1,2-DCE, is about 4 acres in size. The SCAPS membrane interface probe was used to map real-time VOC concentrations in the soil and groundwater within the plume. The presence of fuel hydrocarbons made it difficult to differentiate VOCs, so total ion counts

were measured. In situ chemical oxidation using Fenton's reagent was selected to treat the plume because it can completely oxidize contaminants to carbon dioxide and water; it is also cost effective and relatively quick. Mr. Wong described the pilot test objectives, design, and results. He showed 3-D simulations of the three pilot tests injections. In summary, the technology facilitated mass reduction of contaminants and was effective for source removal, although it may not be applicable to obtain water quality objectives. There was evidence of Fenton's type reaction and soil contamination was also reduced at and below the water table. Full-scale remediation using in situ chemical oxidation is planned to begin in the summer.

To view Mr. Wong's presentation materials for more details for more details, click here: Video Clips: One Two

Questions and Answers

Question: What was the performance standard?
Answer: To achieve greater than or equal to 90% reduction of the contaminant mass.

Question: How do you know that the hydraulic conductivity of the formation was not affected?
Answer: We conducted slug tests pre- and post-injection.

Question: Did you monitor off-gases?
Answer: Yes. There was some mass transfer to the vapor phase attributable to the exothermic reaction that takes place. Off-gassing was not significant, however, and did not impact the breathing zone.

Question: What if the concentrations rebound six months following the cleanup? Will you have to line up a new contractor to finish treatment?
Answer: No. We expect to use a performance-based subcontract so the contractor will have to return to the site.

Question: Did you measure the change in hydraulic gradient during the injections?
Answer: Yes. The water level elevations showed a mounding effect, but we did not see an increase in concentrations in the distal wells.

Question: Have you considered the implications of killing off the native microbes in the soil and ground water with respect to natural attenuation?
Answer: Yes. However, we expect that the site will return to anaerobic conditions and the microbial populations to return.

Question: Are there any disadvantages to using contaminant reduction as a measure of success?
Answer: We actually saw some increases in concentration in some of the wells, but the overall mass decreased, indicating the technology was working.

Steam Enhancement
Merry Coons, IT Group

Merry Coons discussed the pilot test of steam enhancement at Installation Restoration Site 9 at the Naval Air Station, North Island. During the 1940s-70s, 3.2 million gallons of liquid waste were disposed at the "fiery marsh." TCE is now the major risk driver at the site, and the Navy's objective is to reduce TCE to reduce risk. Initially, a 3,000 SCFM system was installed and operated for 26 months. The results showed a decrease of about 80,000 lbs of mixed VOCs. However, the results showed non-typical SVE response, so an additional investigation was performed in 1998. JP-5 was

found to be commingled with about 20 wt% TCE. As a result, a pilot-scale steam enhancement system was installed to address the TCE in JP-5. Ms. Coons described the components of the pilot test and the findings, which were good. The steam enhancement system effectively mobilized the free product JP-5 and TCE to the capture wells. From September 1999 to May 2000, more than 14,600 lbs of liquid waste were removed by skimming, and more than 14,000 pounds were removed by vapor extraction.

Field Trips

As part of the field trip to SSC San Diego, Mark Newhouse (USGS) demonstrated the Borehole Acoustic Doppler Velocimeter in a well at the Naval Aviation Depot, North Island. Site. In addition Rich Wong and Merry Coons (IT Group) led a tour of Installation Restoration Sites 5 and 9 at Naval Air Station, North Island. Full-scale application of in situ chemical oxidation at Site 5 is underway. The oxidation process utilizes traditional Fenton's chemistry, including ferrous iron sulfate as a catalyst, hydrogen peroxide as an oxidant, and hydrochloric acid for pH adjustment of the aquifer. Pilot test results indicated an overall reduction of VOCs by 60%, including a 76% reduction of BTEX, 46% reduction of *cis*-1,2-DCE, 63% reduction of vinyl chloride, and 76% reduction of naphthalene. Pilot testing of steam enhancement was conducted at Site 9. Steam injection generally occurred 24 hr/day over six weeks with brief interruptions. The steam injection resulted in vadose zone temperatures of about 212°F. Full-scale implementation will begin in 2001.

GROUND WATER FORUM PRESENTATIONS

Ground Water Contamination to Indoor Air

Kathy Baylor, U.S. EPA/Region 9 RCRA Corrective Action Office

Kathy Baylor summarized Region 9's investigation of a TCE plume's effect on indoor air at a nearby housing development. A GTE Government Systems facility operated on the site between 1952 and 1993, contaminating the ground water with TCE and 1,1,1-TCA. In the early 1990s the facility buildings were razed, and in1995, the site was redeveloped for residential use. The houses on the 60-acre property were built with gas barriers consisting of plastic over a gravel vent section. The houses are constructed on a slab at grade with no basements. At closing, the residents received forms that informed them that there was a TCE plume in the subsurface.

The subsurface at the site consists of interbedded silts and clays with sand and gravel. Ground water is present at approximately 20 feet bgs. A pump and treat system is being used for containment of the plume.

Region 9 investigated seven homes above the primary area of contamination and two reference homes. Two ambient air samples were collected in two backyards. Sampling was conducted during the spring and fall. Indoor air samples were collected over a 24-hour period with 6-liter Summa canisters. The samples were analyzed for TCE, DCE, and vinyl chloride by GC/MS using a TO15 analysis with selected ion mode as developed by the Colorado DPHE. This method allows you to zero in on a select number of VOCs and provides better quality data than general scan methods such as 8260. Results indicated that the houses were generally below the 10^{-6} cancer risk level, with the exception of one house that consistently had 10^{-5} risk levels, despite the in-place gas barrier.

The sample collection included the following design parameters: the canisters were set at the height of a 3-year old child; and in order to ensure they operated for the full 24-hours, the flow rate was set to leave a final negative pressure of 4 inches of mercury.

Rough calculations using the Nazaroff-Little and Johnson-Ettinger models indicated that the models may not be conservative. The indoor air TCE concentrations were consistent with ground water and soil gas data, and there did not appear to be any interference with household chemicals. Ms. Baylor noted that the work presented is not an endorsement of the Johnson-Ettinger model. The model likely works at this site because of the new construction and vapor barriers installed. These features are not likely to be present at most sites. Therefore, the model should be ground-truthed if it is to be used.

Questions and Answers

Comment: While analyzing specifically for contaminant plume constituents helps determine the plume impact, other chemicals in the home that are not part of the plume will contribute to risk. So a TCE concentration by itself may have a risk of 10^{-5}, but when combined with other chemicals such as carpet glues, formaldehyde, etc., the risk may rise to 10^{-4} or 10^{-3}. Therefore, for an estimate of overall risk, you might want to consider a full VOC suite in addition to TO15.

Question: One of our sites has a plume intersecting an office building. Instead of sampling indoors, the owners sampled soil gas with drive points into Summa canisters. Do you see an advantage in sampling indoor air as opposed to soil gas close to the building?
Answer: The concentrations of the soil gas outside the building footprint may not be representative of what is under the building and are probably not representative of what the people in the building are

actually breathing. Also, a lot of homes have a slight negative pressure so they tend to draw VOCs in.

Question: If you don't run the Johnson and Ettinger model, what do you use?
Answer: There really isn't another option.

Question: How does the Johnson and Ettinger model account for vapor barriers?
Answer: It does not. And if the barriers were not there, the model would have vastly under-predicted the risk.

Question: Did you institute any control on air conditioning and open windows?
Answer: No, we just asked the homeowners to go about their day as they normally would.

Ground Water Contribution to Sediment Recontamination at the Thea Foss Waterway, Commencement Bay, in Tacoma, Washington

Howard Orlean, U.S. EPA/Region 10

Commencement Bay has been on the NPL since the early 1980s. The site has nine operable units—seven of which are waterways. The investigation at Commencement Bay involves several hundred PRPs, two tribes, five federal agencies and three state agencies. Howard Orlean discussed the ongoing work at the head of the Thea Foss Waterway. Two 96-inch culverts receive runoff from a 200 square mile drainage area. On one side of the culverts, a former manufactured gas plant has contributed a large coal tar problem. The sediments in the area can contain 0.25 percent PAHs, and coal tar seeps cause a bluish sheen on the water. When storm water is present, a brownish sheen appears due to oil from surface runoff from the uplands. Sediment cores taken in the waterway indicate that DNAPL contamination is present to depth.

Region 10 established sediment quality objectives for PAHs. At this site, the sediment quality objective is 17,000 µg/kg, which is exceeded by up to five times. A cross-section of the sediments shows very high contamination in the deeper sediments, directly associated with the presence of DNAPL, and a cleaner but still contaminated layer above. This contamination could be an example of ground water that becomes contaminated as it moves through the DNAPL and loses some of the contaminants to the cleaner overlying sediments.

The ROD written in 1989 was a programmatic ROD that laid out some generic options for the sediments (e.g., capping, dredging) but did not pick a remedy for specific waterways. It also allowed for the use of sorbent materials as part of the remedy. Tacoma's proposal for the remedy is to use a sorbent cap to prevent seeps and other contaminants from reaching the surface water. Part of the proposed remedy will include a sheet wall barrier that will be cut off at the mud line. This barrier will be perpendicular to the waterway, and its prime function will be for stability since the sediments to the north will likely be dredged for navigation. After some leveling of the waterway sediment base, a geogrid filtering barrier will be laid down. On top of this will be a sorbent material (EC-100) that is primarily montmorillonite clay. As part of the source control, the PRPs have agreed to remove the coal tars from the west bank (not the DNAPL). The city estimates that greater than 50% of the potential for recontamination comes from the ground water, with most of the remaining potential coming from the storm water. However, they have not actually sampled the ground-water flux or storm water flux, so they don't have actual numbers to plug into their model.

Questions and Answers

Question: Will the sheet pile be an impermeable grout or typical sheet pile?
Answer: Typical sheet pile.

Question: Have they evaluated what is happening with the NAPL itself?
Answer: No.

Question: In San Diego, there is a program to replace creosote-treated pilings to help with the PAH problem in the bay. Is anything like that happening in the Seattle area?
Answer: Yes it has begun, but is not yet a large effort.

Evaluating Innovative Ground-Water Technologies

Ruth Izraeli, U.S. EPA/Region 2

Ruth Izraeli noted there has been a large number of innovative ground-water remediation technologies introduced recently. It is often difficult to learn enough about them to evaluate their inclusion in feasibility studies and to choose among them for remedy selection. There are a number of resources available on the web including http://www.reachit.org/index.html, http://cluin.org/techfocus, and http://hillafb.hgl.com. However, the quality is uneven and it takes a large amount of time to sift through them. Therefore, she proposed that the Ground Water Forum take on a project to provide one- to two-page summary sheets that provide a short description of how each technology works, its current status (e.g., proven, demonstrated, research), specific benefits that make it stand out (e.g., eliminates above-ground treatment requirements), and specific problem areas either in terms of the actual performance or in terms of site-specific situations where it is unlikely to perform well (e.g., interbedded sequences). The summary sheet might also include several readily available references for more information. For discussion purposes, Ms. Izraeli handed out a draft technical summary sheet she prepared on Ground-Water Circulating Well Technology and asked for comments on it.

Comparison of Cone Penetrometer Testing Data and Monitoring Well Data

Kathy Davies, U.S. EPA/Region 3

Kathy Davies compared cone penetrometer testing (CPT) data and monitoring well data from Aberdeen Proving Grounds in Aberdeen, Maryland. The data from Aberdeen Proving Grounds were collected from monitoring wells, Geoprobe holes, piezometers (constructed the same as monitoring wells but in smaller borehole), and supply wells. Analysis of water in the supply wells showed a number of different results ranging from non-detect of VOCs to one sample having MTBE, PCE, TCE, and DCE in detectable quantities. Analysis of water from monitoring wells located in the area showed some contamination, but not necessarily the same type or quantity as found in the nearest supply well. This led to a Geoprobe investigation to try to reconcile the differences. Results from the Geoprobe holes (placed around a selection of the wells) were markedly different than those found in the wells. For example, some Geoprobe holes contained contamination when the wells did not and vice versa. Ms. Davies did a lot of comparative analysis of stratigraphy and sampling techniques and found no obvious explanation for the differences. The explanation could be subtle differences in where the water was drawn from or sampling techniques, but the point still remains that approved sampling and analysis plans have produced data that, if taken alone, would produce different decisions about the level of risk at the site.

Ms. Davies also provided an overview of a DNAPL site in a fractured rock setting at a military base, the Naval Air Warfare Center. NAWC operated between 1944 and 1996. It occupied 734 acres in a

suburban setting with light industry and residential areas. NAWC is on the NPL and is contaminated primarily with TCE, PCE, and CCl_4. The underlying aquifer is fractured rock (alternating sandstones and shales) overlain by 10-15 feet of soil. Drinking water is provided by municipal supply wells. One well is about 2,000 feet down dip and downgradient from the source areas.

During an early investigation ,TCE at 130 µg/L was detected in a shallow bedrock monitoring well. During the Phase 1 investigation, a slightly deeper well was found to contain 2 mg/L of TCE. This led the installation of yet a deeper well, and it contained 100 mg/L TCE. At this point, the presence of DNAPL was suspected. This slowed down the drilling investigation because of the concern that connecting fractures that could lead to contamination of a downgradient supply well.

The ROD called for a pump and treat remedy. A line of pumping wells in the source area near the base boundaries was proposed for containment. Before drilling in the source area, the Navy installed monitoring wells downgradient of the source to act as an early warning system for the supply well. In 1999, an extraction system of 14 wells and four more monitoring wells was installed. Wells were sampled prior to drilling, and as drilling occurred, wells within 200 feet of the location were periodically sampled. The wells were drilled using air rotary with the cuttings, air and water samples being monitored with a PID and GC. A DNAPL contingency plan was implemented. The plan specified that a negative pressure be maintained on any well suspected of DNAPL so the material would flow to the well, not away from it. They had a 24-hour notification system and a technical evaluation group that was made up of the Navy, EPA, and a local USGS expert.

The extraction wells were installed sequentially. One well would be drilled, and a pumping test was run on it with real-time chemistry on the pumped water and monitoring wells. The technical team reviewed these data and determined where to put the next extraction well. Open borehole tests were conducted to estimate aquifer transmissivity, well pumping capacity, and capture zone. They performed the standard suite of downhole geophysical techniques including a heatpulse flowmeter. Dye tests were used to determine if DNAPL was present. The area of DNAPL area was successfully delineated and a technical impracticability waiver was issued for this portion of the aquifer.

ENGINEERING FORUM PRESENTATIONS

Bacterial Adaptation for Intrinsic Bioremediation of PAHs in Harbor Sediments

Mike Montgomery, U.S. Naval Research Lab

Mike Montgomery noted that there are several problems that arise when measuring intrinsic bioremediation in harbor sediments. First of all, engineering models, strategies, and biases are used to study processes dominated by microbial ecology. Ground water models are often used to describe riverine and estuarine systems. In addition, companies devote few resources to the evaluation of intrinsic bioremediation because of cost issues. Regulators and stakeholders are left to evaluate intrinsic bioremediation using messy data sets.

Mr. Montgomery provided datasets showing that at some level of PAH concentration, bacterial metabolism is inhibited. This level appears to be ecosystem specific. Molecular methods show that the bacterial assemblage changes rapidly upon exposure to PAHs. Comparing ratios of PAH mineralization to production suggests that some sediments are adapted to chronic PAH exposure. Ambient PAH concentrations in areas with high sediment dynamics may be a misleading indicator of risk to the ecosystem. Determining turnover rates helps to identify areas of high PAH flux. By surveying an ecosystem over time and measuring a few chemical and biological parameters, one may obtain valuable information on the environmental regulation of hydrocarbon degradation.

To view Mr. Montgomery's presentation materials for more details, click here:

Questions and Answers

Question: Has a flux meter been used in Charleston?
Answer: No.

Question: If the input goes away at the Philadelphia ship yard, will the sink eventually clear itself up?
Answer: Yes, the key is to measure the turnover time.

PAH Degradation in an Intertidal Salt Marsh

Thomas Boyd and Mike Montgomery, U.S. Naval Research Laboratory

Conventional analytical parameters often do not define the amount of bioremediation occurring. Chemical concentrations and bacterial enumeration are often used as proxies for bioremediation. Concentrations may vary based on seasonal rains, primary productivity, or sample heterogeneity. Bacterial abundance is dictated by grazer populations, nutrient concentrations, carbon availability, and viral mortality. To address these concerns, researchers need to couple chemical and biological measurements to determine the contaminant's role in the overall carbon cycle.

A comprehensive RI/FS study was conducted between 1993 and 1995 at a former creosote wood treating plant. Soil, ditch sediments, marsh sediments, river sediments, and ground water were found to contain elevated concentrations of potentially carcinogenic PAHs. Sediments in the south marsh also contained isolated areas of lead contamination from an adjacent fertilizer manufacturing facility. An ERA concluded sediments adjacent to the headwaters of both the north and south tidal marshes were toxic to test species evaluated. PAH concentrations were determined using solvent extraction and GC/MS analysis. Surface sediments were also collected from the upper 1 mm of marsh sediment. Production and PAH concentrations varied with season and contaminant. Production varied considerably, but showed highest values at the highest temperatures, while PAH mineralization was

lowest as the lowest temperatures. Zinc appeared to have little affect on bacterial production. There was a negative relationship between increasing PAH concentration and production. There was also a negative relationship between increasing naphthalene concentration and naphthalene mineralization. There was a slight positive relationship between increasing phenanthrene concentration and phenanthrene mineralization. Finally, there was a negative relationship between increasing fluoranthene concentration and fluoranthene mineralization.

Lt. Boyd presented his research findings from the Cooper River site (near Charleston, SC) and from the Philadelphia Naval Complex. At Cooper River, PAH concentration and PAH mineralization were positively related. At Philadelphia, production was negatively related to PAH concentration. In contrast, phenanthrene and fluoranthene mineralization were not inhibited by, and may have been stimulated by higher concentrations of PAH substrate.

To view Lt. Boyd's presentation materials for more details, click here:

Questions and Answers

Question: Which PAH takes the longest to mineralize?
Answer: Naphthalene has the lowest degradation rate, but we have not measured the rates of any 4-ring PAHs.

Question: There appears to be lots of flux over time. Is it a challenge to track where you are in the process and where your endpoint might be?
Answer: Yes; the problem with cleanup goals is that you have to cut off all sources.

Question: How do you discuss these issues with the community?
Answer: We hold lots of meetings with state regulators. In Charleston, the Navy has been blamed for all of the contamination. Both the public and those determining the cleanup level must be educated.

Question: What sort of biota monitoring has been done?
Answer: Our laboratory has not done any biota research. Snails and Spartina have been examined in other studies.

Question: Most contaminants in sediments are slow to biodegrade. Can you infer anything from lower end and higher end compounds?
Answer: The three compounds were chosen because they were readily available. To see compounds with higher molecular weights degrade, we must do the experiments in the laboratory.

Question: Do you conduct toxicology studies?
Answer: No

Question: When mineralization occurs, how much memory do the bacteria have in terms of tolerance?
Answer: When we sample, we do 12-24 hour incubation. The bacteria compete with each other.

Question: If you had a wish list of things that EPA could do, what would be your number one priority?
Answer: A project to look at sediments that have been buried for decades. Also, higher resolution remote sensing.

Question: Can you convince investigators to examine the pulp mill as a possible contributor to the contamination?
Answer: The pulp mill is open and employs many people. The Navy base has been shut down and is an easy scapegoat.

Sediment Management Strategies

Sabine Apitz, Director, SSC San Diego/Sediment Management Laboratory

Marine sediments and Navy activities are inseparable. Marine sediments are the ultimate receptor of effluent from all Navy activities, both at sea and on shore. As a result, regulation of sediments can impact all Navy activities. Increasing regulatory scrutiny and tightening standards increases costs and limits operational flexibility. At the Navy's numerous sediment sites, a consistent approach is not always applied. While some view sediments as a non-issue, others feel that operations are being impacted. Regulators are signaling an intent to apply more scrutiny to sediment issues, which are highly politicized and newsworthy. In addition, there is little incentive for contractors, regulators, stakeholders, or RPMs to streamline the process.

Contaminated sediment sites must be ranked and prioritized, and cost-effective management strategies must be developed. It is assumed that the management process will seek to balance two parallel goals: minimizing contaminant risk to the environment and human health and minimizing cost. Effectively managing contaminated sediments is complex because of its interdisciplinary and multi-level nature. Science must be linked with regulatory frameworks, politics, engineering, economics, public relations, and policy. An RPM has a wide set of options when making sediment management decisions, including no action, removal, in-place treatment, containment, ex situ treatment, and upland disposal.

Ms. Apitz discussed where contaminants can be found in sediment, where they go, and methods and strategies for detecting, containing, and removing them. It is important to become familiar with data management practices for decision making when determining which methods will work at a particular site.

To view Ms. Apitz's presentation materials for more details, click here:

Questions and Answers

Question: Has the Navy put out guidance addressing these points?
Answer: The Navy is working on guidance documents for many of these sediment issues. When the they are finished with the internal Navy review, they will be sent to EPA for review.

FEDERAL FACILITY FORUM PRESENTATIONS

UXO Training

Harry Craig, U.S. EPA/Region 10 Oregon Operations Office

Harry Craig provided an update on several training efforts regarding sites with UXO contamination:

- EPA's Office of Enforcement has developed a broad-based RPM training course, "Ordnance and Explosives at CTT Ranges," that will be offered as a pilot on July 17-19, 2001, in Dallas, Texas. The course subsequently will be made available to all EPA regions and states. Course components include:
  - the systematic planning process
  - collection of historical information
  - a framework for building a conceptual site model
  - tools for conducting site investigations, selection of detection technologies, quality assurance/quality control, sampling and analysis plans, and field/laboratory techniques and their applications
  - safety considerations in conducting UXO investigations
  - case study exercises
  - risk management approaches
  - options for remediation, and
  - regulatory frameworks and issues.

- The ITRC is developing a UXO course consisting of four specific training components: basic issues concerning UXO contamination; site characterization; site remediation; and regulatory frameworks.

- The Navy is developing a training course on management of UXO sites, with particular focus on remediation.

- The U.S. Army Corps of Engineers' Cold Regions Research and Engineering Laboratory is completing development of an Internet-based training module focusing on UXO analytical methods. As sponsors of the project, TIO plans to release this module on June 4, 2001.

Continued efforts are underway by EPA to establish an effective risk model for UXO waste, and to more clearly understand what constitutes an acceptable risk where UXO is involved.

Toxicity Studies with Ordnance-Contaminated Marine Sediments,

R. Scott Carr, USGS/Marine Ecotoxicology Research Station

In response to the State of Washington's requirement for ordnance contaminant removal to levels below detection, and the lack of existing data on ordnance compound toxicities, researchers from the USGS, Texas A&M, and the Naval Facilities Engineering Service Center collaborated in efforts to gather toxicity data concerning eight ordnance compounds of concern in Puget Sound marine sediments. Using five marine species and nine toxicity test endpoints, a database was established to identify the most sensitive species/endpoints and most toxic ordnance compounds. Studies showed polychaete reproduction, macro-algo germling growth, and sea urchin embryological growth to be most sensitive, and tetryl and 1,3,5-trinitrobenzene to be most toxic of the ordnance compounds tested.

Porewater toxicity tests then were conducted at two naval facilities to determine the extent and degree of toxicity within Puget Sound. Based on the results of porewater analysis, specific sites were selected in which to conduct toxicity identification evaluation (TIE). TIE studies indicated that the ordnance compounds of concern were not responsible for the observed toxicity. Lastly, researchers conducted sediment spiking studies, which found that compounds behave differently in different sediment types, and that 2,6-dinitrotoluene, tetryl, and picric acid had degraded or irreversibly bound to the sediment. Overall, researchers found that degradation products can play a major role in sediment toxicity and effects to the benthic biota.

Future studies are needed to examine specific aspects of ordnance contaminant degradation, including the impact of sediment type, effect of ultraviolet light, and the likelihood for complete mineralization. Additional information is available from Dr. Carr at scott.carr@usgs.gov or from the Internet at http://www.sci.tamucc.edu/mers/.

To view Dr. Carr's presentation materials for more details, click here:

Phytoextraction Applications for Remediation of Lead Contaminated Soils

Michael Blaylock, Ph.D., Edenspace Systems Corporation

Michael Blaylock discussed various factors to be considered and methods to be used in the phytoextraction of lead from soil. Heavy metals are relatively insoluble and unavailable for plant uptake, and in particular, no hyperaccumulators of lead have been identified. Phytoextraction has been successful, however, through induced methods using soil and foliar amendments. At Fort Dix, for example, phytoextaction induced by chelating agents (EDTA) resulted in a 50 percent reduction of lead in soil, with final TCLP concentrations of less than 1 mg/kg. Techniques to reduce and minimize leaching to subsurface soil, which has shown to be a problem in ex situ phytoextraction systems, such as that used at Fort Dix, continue to be investigated.

To view Dr. Blaylock's presentation materials for more details, click here:

Questions and Answers

Question: Does the addition of EDTA increase the toxicity of chemicals being extracted?
Answer: Chemical toxicity may be increased over a short time (approximately one day), but no long-term effects have been identified.

Question: Can these methods be used effectively for removing contaminants comprising both metals and PAHs?
Answer: Edenspace Systems Corporation conducted a related study in cooperation with Cornell University, and found mixed results.

Question: How does the cost for phytoextraction compare to other remediation methods?
Answer: With an estimated cost range of $40-76 per cubic yard, phytoextraction costs are lower than those involved in other techniques such as stabilization. In addition, the ability to use soil treated through phytoextraction as top soil avoids the disposal costs incurred with many other technologies.

Question: Can phytoextraction be used for mercury?
Answer: Removal of mercury through phytoextraction is very difficult. Researchers at the University of Florida have identified certain plants with capabilities to enhance mercury volatilization, but no hyperaccumulators for mercury have been identified.

Question: Do contaminants also accumulate in the seeds of plants used in phytoextraction?
Answer: Contaminant accumulation in seeds has not posed a problem because plants used for extraction usually are harvested prior to seed formation.

Question: Do any garden vegetables serve as effective accumulators?
Answer: Garden vegetables uptake little, if any, contaminants from soil.

Integration of WRDA Restoration and CERCLA Remedial Processes at Urban Waterway Superfund Sites

Paul Fuglevand, Dalton, Olmsted & Fuglevand, Inc.

Paul Fuglevand provided an overview of an environmental restoration process that may be used as an alternative to the Superfund Program for addressing sediment contamination in urban waterways. Under the Water Resources Development Act of 1999 (WRDA 99), this process provides a framework for cost-sharing partnerships among federal government and non-federal parties under the sponsorship of local government. In contrast to determining liability for cleanup under Superfund, the WRDA approach is based on proving the benefits of obtaining voluntary funds from PRPs that may be used to leverage additional federal and non-federal resources. The WRDA process currently is used for sediment remediation in Portland Harbor, where public involvement through the program's local sponsor has become a primary driver of the project over the past 3-5 years. Other U.S. Army Corps of Engineers projects using a joint WRDA/CERCLA approach are underway in Ashtabula, Ohio, and the Lower Pasaic River, New Jersey.

To view Mr. Fuglevand's presentation materials for more details, click here:

Questions and Answers

Question: How does this process reflect the need for scientific validation?
Answer: The Corps of Engineers recognizes the need for scientific data in order to obtain Superfund funding and currently is working to address this issue.

Question: Is Portland Harbor a Superfund site?
Answer: Yes, the site consists of a six-mile stretch of land along Portland Harbor.

Question: What is the impact of DOD involvement other than the Corps of Engineers, particularly with respect to budgets and authorities?
Answer: The Corps recognizes the sensitivities and challenges presented by the involvement of other DOD sectors, but attempts to focus on the overall benefit of the project at hand.

Question: Has the WRDA Program been impacted by Congressional involvement in the past?
Answer: Yes. Although Congress similarly needs to demonstrate project benefits to the public, Congressional funding may be appropriated for WRDA projects very quickly.

Question: How may the WRDA process be applied at federal facilities?
Answer: Various scenarios could exist, but one example would be a closed federal facility that is part of a larger Superfund site.

Question: Isn't it recognized that this process may present CERCLA conflicts of interest because the Corps of Engineers, as a PRP, is actually receiving restoration funding instead of providing funds as part of cost recovery?

Answer: Much Congressional debate on this issue and the process in general is anticipated over the next six months. As part of the debate, Congressional language may be drafted to further clarify that polluters must pay.

Manual Integration Policy Used in Region 5's Federal Facilities Response Section

Gary Schafer, U.S. EPA/Region 5

Gary Schafer provided a background on issues leading to the development of a GC/MS manual integration policy that is now implemented in Region 5's Federal Facilities Response Section. Manual integration of environmental data involves the discretionary adjustment of laboratory report peaks and spacing to provide estimates after field samples are processed. Data errors resulting from manual integration most recently posed problems at the Chanute Air Force Base, where EPA, the state, and AFCEE agreed that the reliability of data should be questioned.

To better understand the reliability of this approach, manually integrated data results were compared to corresponding raw data, and the findings indicated that manual integration can result in faulty interpretations. Current QAPP requirements in Region 5, however, do not contain specific provisions for manually integrated data. As a result of the Air Force's reluctance and occasional refusal to incorporate into its QAPPs the appropriate language needed to limit the use of manually integrated data, as well as Air Force submission of the issue to the Inspector General, extensive discussions with regional chemists, quality assurance experts, and legal staff were held.

As a result, the Region's Federal Facilities Response Section issued a draft revised (version 2.0) policy on April 19, 2001. The policy significantly limits the use of manual integration, requires the use of raw data during RI activities at federal facilities, and requires 100 percent validation of all manually integrated data (which in itself is not legally defensible). The policy also requires any use of manually-integrated data to be accompanied by the reason for its use, pre- and post-manual integration data output, and clear identification on the raw data quantitation report.

To date, the Army and Navy generally have agreed on this policy. Michael Chrystof (Region 5) may be contacted for more information at 312-353-3705.

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